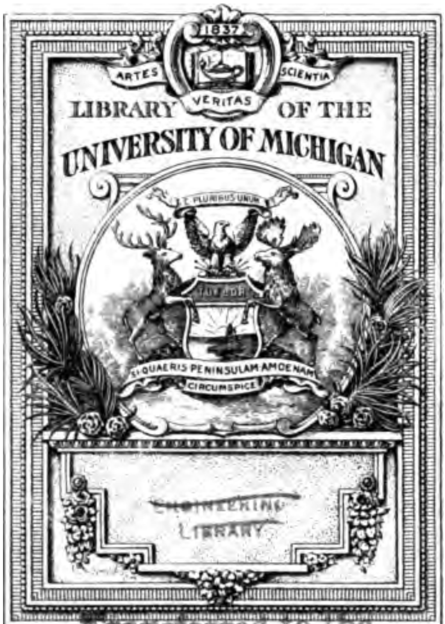
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1896.

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CONTENTS.

No. 77.

The Tactics of Ships in the Line of Battle. (Prize Essay, 1896.) By Lieutenant A. P. Niblack, U. S. N., ... 1
Discussion, ... 28
Speed Control in Modern Steamers. By Lieutenant M. L. Wood, U. S. N., ... 61
A System of Aiming Drill. By Ensign Philip Andrews, U. S. N., 79
The Organization, Training and Discipline of the Navy Personnel as Viewed from the Ship. (Honorably Mentioned.) By Lieutenant Wm. F. Fullam, U. S. N., ... 83
Discussion, ... 116
Naval War College. By Captain H. C. Taylor, U. S. N., President of Naval War College, ... 199
Professional Notes, ... 209
Sights for Ordnance.—Device for Minimizing the Effects of Collisions at Sea.—Improvement in War Material.—Modern Projectiles, by V. G.—The Training of French Naval Officers.—Cordite.—Electric Training Gear.—Silent Setting-Up Drill.—Ships of War.
Book Notices, ... 245
Bibliographic Notes, ... 247
Annual Report of the Secretary and Treasurer of the U. S. Naval Institute, ... 261
Officers of the Institute, ... 265
Prize Essay Notice. Advertisements.

No. 78.

Naval Apprentices, Inducements, Enlisting, and Training. The Seaman Branch of the Navy. By Ensign Ryland D. Tisdale, U. S. N., ... 265
Discussion, ... 295
Electricity in Naval Life. By Lieutenant B. A. Fiske, U. S. N., 323
Naval War College. By Hon. William McAdoo, Assistant Secretary of the Navy, ... 429
Shrinkages (applying Clavarino's Equations). By Lieutenant J. H. Glennon, U. S. N., ... 447
The Dudley Powder-Pneumatic Gun. By Howard P. Elwell, Associate Member U. S. Naval Institute, ... 451
Discussion of "The Organization, Training and Discipline of the Navy Personnel as viewed from the Ship," 471
Discussion of "Speed Control in Modern Steamers," . . . 481
Professional Notes, ... 485
Notes on the Care of Rapid-Fire Guns and Mounts.—New Device for Sailing Ships.—The Bazin Disc Wheel Steamboat.—To Prevent Collisions at Sea.—Wounds by the Bullets of Modern Rifles.—Armor Tests.—Ships of War.
Book Notices and Books Received, ... 527
Bibliographic Notes, ... 529
Officers of the Institute, ... 537
Prize Essay Notice. Advertisements.

No. 79.

The Composition of the Fleet. By Lieutenant John M. Ellicott, U. S. N., ... 537
Discussion, ... 549
The Sea and Sea Power as a Factor in the History of the United States. By Hon. H. A. Herbert, Secretary of the Navy, . 561
Howe and D'Estaing. A Study in Coast Defense. By Commander C. F. Goodrich, U. S. N., ... 577
Telescopic Sights for Guns. By Lieutenant Joseph Strauss, U. S. N., ... 587
Notes on the Literature of Explosives. By Charles E. Munroe, . 599
Homing Pigeons for Sea Service. By Professor H. Marion, U. S. Naval Academy, ... 643
Discussion of "Speed Control in Modern Steamers," . . . 655
Professional Notes, ... 659
On the Perforation of Hard-Faced Armor Plates.—Herr Krupp on the Perforation of Steel Armor.—Armor-Plated Torpedo Boats.—Experiments with Models at the Barrow-in-Furness Ship-Building Yard.—Visibility of Lights at Sea.—The Pneumatic Painter.—Oil Engine Signaling Plant on U. S. Light-Ship, No. 42.—A New Finding Light for War Vessels.—Smokeless Powder in War.—Specifications for Smokeless Powder.—Shooting under Water.—The Largest Ship in the World.—The St. Paul.—Ships of War and Naval Notes.
Book Notices, ... 701
Bibliographic Notes, ... 703
Officers of the Institute. Prize Essay Notice. Advertisements.

No. 80.

The Right of Search and its Limitation in Time of Peace. By Professor Theodore S. Woolsey, ... 721
The Chronology and Geographical Distribution of Icebergs in the Southern and Antarctic Oceans. By W. T. Gray, M. S., . 743
Target Practice at Sea. By Lieut. W. J. Sears, U. S. N., . . 757
Naphtha Fuel for War-Ships. By Lieut. M. Vasilieff, Russian Navy (translated from the Russian by Lieut. John B. Bernadou, U. S. N.), ... 763
Development of Ordnance and Armor in the Immediate Past and Future. By P. R. Alger, Professor of Mathematics, U. S. N., ... 777
Armor and Heavy Ordnance. Recent Developments and Standards. By W. H. Jaques. 795
Professional Notes, ... 803
A General Description of the Whitehead Torpedo.—The United States Battle-Ships Alabama and Class.—Cruisers with Rams.—Liquid Fuel.—Canet's Duplex Mounting for Quick-Firing Guns.—Experimental Ten-Inch Wire Wound Brown Segmental Gun for U. S. Army.—Growth of the U. S. Navy.—Comparison of the Latest Battle-Ships of the Principal Naval Powers.—Ships of War and Naval Notes.
Book Notices, ... 845
Bibliographic Notes, ... 849
Officers of the Institute, ... 865
Prize Essay Notice. Advertisements.

Vol. XXII., No. 1. 1896. Whole No. 77.

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CONTENTS.

THE TACTICS OF SHIPS IN THE LINE OF BATTLE. Prize Essay, 1896. By Lieutenant A. P. Niblack, U. S. N., ... 1

Discussion:

Commander C. F. Goodrich, U. S. N., 28.—Lieutenant John M. Ellicott, U. S. N., 30.—Lieutenant Wm. F. Fullam, U. S. N., 32.—Lieutenant Spencer S. Wood, U. S. N., 34.—Lieut.-Comdr. Richard Wainwright, U. S. N., 37.—Lieutenant R. C. Smith, U. S. N., 38.—Rear-Admiral S. B. Luce, U. S. N., 43.—Lieutenant A. A. Ackerman, U. S. N., 48.—Ensign Philip Andrews, U. S. N., 55.—Captain H. C. Taylor, U. S. N., 58.

SPEED CONTROL IN MODERN STEAMERS. By Lieutenant M. L. Wood, U. S. N., ... 61

A SYSTEM OF AIMING DRILL. By Ensign Philip Andrews, U. S. N., . . 79

THE ORGANIZATION, TRAINING, AND DISCIPLINE OF THE NAVY PERSONNEL AS VIEWED FROM THE SHIP. Honorably Mentioned. By Lieutenant Wm. F. Fullam, U. S. N., ... 83

Discussion:

Captain R. D. Evans, U. S. N., 116.—Commander J. B. Coghlan, U. S. N., 119.—Lieut.-Comdr. W. J. Barnette, U. S. N., 124.—Ensign Philip Andrews, U. S. N., 125.—Ensign T. P. Magruder, U. S. N., 126.—Commander F. E. Chadwick, U. S. N., 127.—Commander C. H. Davis, U. S. N., 131.—Lieutenant W. H. Halsey, U. S. N., 133.—Lieutenant J. M. Bowyer, U. S. N., 136.—Lieutenant A. L. Key, U. S. N., 137.—Commander Chas. M. Thomas, U. S. N., 138.—Lieutenant H. S. Knapp, U. S. N., 139.—Lieutenant F. J. Haeseler, U. S. N., 141.—Commander C. F. Goodrich, U. S. N., 143.—Lieutenant F. K. Hill, U. S. N., 147.—Lieutenant Harry P. Huse, U. S. N., 149.—Ensign W. W. Phelps, U. S. N., 152.—Lieutenant J. M. Ellicott, U. S. N., 152.—Lieutenant Bradley A. Fiske, U. S. N., 156.—Lieut.-Comdr. Richard Wainwright, U. S. N., 156.—Lieutenant A. P. Niblack, U. S. N., 158.—Lieutenant G. B. Harber, U. S. N., 160.—Lieutenant Albert Gleaves, U. S. N., 160.—1st Lieutenant Charles A. Doyen, U. S. Marine Corps, 160.—Lieutenant C. S. Richman, U. S. N., 168.—Lieutenant C. E. Colahan, U. S. N., 169.—Commander W. M. Folger, U. S. N., 170.—Commander J. N. Hemphill, U. S. N., 171.—Commander C. C. Todd, U. S. N., 172.—Captain P. F. Harrington, U. S. N., 173.—Lieut.-Comdr. Uriel Sebree, U. S. N., 178.—Rear-Admiral S. B. Luce, U. S. N., 180.—Lieutenant H. C. Poundstone, U. S. N., 183.—Lieutenant C. H. Lauchheimer, U. S. M. C., 184.

NAVAL WAR COLLEGE. By Captain H. C. Taylor, U. S. N., President of Naval War College, ... 199

PROFESSIONAL NOTES, ... 209

Sights for Ordnance.—Device for Minimizing the Effects of Collisions at Sea.—Improvement in War Material.—Modern Projectiles, by V. G.—The Training of French Naval Officers.—Cordite.—Electric Training Gear.—Silent Setting-Up Drill.—Ships of War.

BOOK NOTICES, ... 245

BIBLIOGRAPHIC NOTES, ... 247

ANNUAL REPORT OF THE SECRETARY AND TREASURER OF THE U. S. NAVAL INSTITUTE, ... 261

OFFICERS OF THE INSTITUTE, ... 265

PRIZE ESSAY NOTICE. ADVERTISEMENTS.

NOTICE.

ANNAPOLIS, MD., *February 12, 1896.*

Having carefully read the four essays submitted in competition for the prize offered by the U. S. Naval Institute for the year 1896, we have the honor to announce that, in accordance with Article XI. of the Constitution, the prize is awarded to the essay bearing the motto, "In making these recommendations, I am fully alive to the full responsibility incurred and keenly realize all the consequences that may follow" on the Tactics of the Ship in the Line of Battle, by Lieutenant A. P. Niblack, U. S. Navy.

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H. G. DRESEL,
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CONTENTS.

No. 77.

The Tactics of Ships in the Line of Battle. (Prize Essay, 1896.)
By Lieutenant A. P. Niblack, U. S. N., ... 1
Discussion, ... 28
Speed Control in Modern Steamers. By Lieutenant M. L. Wood, U. S. N., ... 61
A System of Aiming Drill. By Ensign Philip Andrews, U. S. N., 79
The Organization, Training and Discipline of the Navy Personnel as Viewed from the Ship. (Honorably Mentioned.) By Lieutenant Wm. F. Fullam, U. S. N., ... 83
Discussion, ... 116
Naval War College. By Captain H. C. Taylor, U. S. N., President of Naval War College, ... 199
Professional Notes, ... 209
Sights for Ordnance.—Device for Minimizing the Effects of Collisions at Sea.—Improvement in War Material.—Modern Projectiles, by V. G.—The Training of French Naval Officers.—Cordite.—Electric Training Gear.—Silent Setting-Up Drill.—Ships of War.
Book Notices, ... 245
Bibliographic Notes, ... 247
Annual Report of the Secretary and Treasurer of the U. S. Naval Institute, ... 261
Officers of the Institute, ... 265
Prize Essay Notice. Advertisements.

No. 78.

Naval Apprentices, Inducements, Enlisting, and Training. The Seaman Branch of the Navy. By Ensign Ryland D. Tisdale, U. S. N., ... 265
Discussion, ... 295
Electricity in Naval Life. By Lieutenant B. A. Fiske, U. S. N., 323
Naval War College. By Hon. William McAdoo, Assistant Secretary of the Navy, ... 429
Shrinkages (applying Clavarino's Equations). By Lieutenant J. H. Glennon, U. S. N., ... 447
The Dudley Powder-Pneumatic Gun. By Howard P. Elwell, Associate Member U. S. Naval Institute, ... 451
Discussion of "The Organization, Training and Discipline of the Navy Personnel as viewed from the Ship," 471
Discussion of "Speed Control in Modern Steamers," . . . 481
Professional Notes, ... 485
Notes on the Care of Rapid-Fire Guns and Mounts.—New Device for Sailing Ships.—The Bazin Disc Wheel Steamboat.—To Prevent Collisions at Sea.—Wounds by the Bullets of Modern Rifles.—Armor Tests.—Ships of War.
Book Notices and Books Received, ... 527
Bibliographic Notes, ... 529
Officers of the Institute, ... 537
Prize Essay Notice. Advertisements.

No. 79.

The Composition of the Fleet. By Lieutenant John M. Ellicott, U. S. N., ... 537
Discussion, ... 549
The Sea and Sea Power as a Factor in the History of the United States. By Hon. H. A. Herbert, Secretary of the Navy, . 561
Howe and D'Estaing. A Study in Coast Defense. By Commander C. F. Goodrich, U. S. N., ... 577
Telescopic Sights for Guns. By Lieutenant Joseph Strauss, U. S. N., ... 587
Notes on the Literature of Explosives. By Charles E. Munroe, . 599
Homing Pigeons for Sea Service. By Professor H. Marion, U. S. Naval Academy, ... 643
Discussion of "Speed Control in Modern Steamers," . . . 655
Professional Notes, ... 659
On the Perforation of Hard-Faced Armor Plates.—Herr Krupp on the Perforation of Steel Armor.—Armor-Plated Torpedo Boats.—Experiments with Models at the Barrow-in-Furness Ship-Building Yard.—Visibility of Lights at Sea.—The Pneumatic Painter.—Oil Engine Signaling Plant on U. S. Light-Ship, No. 42.—A New Finding Light for War Vessels.—Smokeless Powder in War.—Specifications for Smokeless Powder.—Shooting under Water.—The Largest Ship in the World.—The St. Paul.—Ships of War and Naval Notes.
Book Notices, ... 701
Bibliographic Notes, ... 703
Officers of the Institute. Prize Essay Notice. Advertisements.

No. 80.

The Right of Search and its Limitation in Time of Peace. By Professor Theodore S. Woolsey, ... 721
The Chronology and Geographical Distribution of Icebergs in the Southern and Antarctic Oceans. By W. T. Gray, M. S., . 743
Target Practice at Sea. By Lieut. W. J. Sears, U. S. N., . . 757
Naphtha Fuel for War-Ships. By Lieut. M. Vasilieff, Russian Navy (translated from the Russian by Lieut. John B. Bernadou, U. S. N.), ... 763
Development of Ordnance and Armor in the Immediate Past and Future. By P. R. Alger, Professor of Mathematics, U. S. N., ... 777
Armor and Heavy Ordnance. Recent Developments and Standards. By W. H. Jaques, ... 795
Professional Notes, ... 803
A General Description of the Whitehead Torpedo.—The United States Battle-Ships Alabama and Class.—Cruisers with Rams.—Liquid Fuel.—Canet's Duplex Mounting for Quick-Firing Guns.—Experimental Ten-Inch Wire Wound Brown Segmental Gun for U. S. Army.—Growth of the U. S. Navy.—Comparison of the Latest Battle-Ships of the Principal Naval Powers.—Ships of War and Naval Notes.
Book Notices, ... 845
Bibliographic Notes, ... 849
Officers of the Institute, ... 865
Prize Essay Notice. Advertisements.

Vol. XXII., No. 1. 1896. Whole No. 77.

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CONTENTS.

THE TACTICS OF SHIPS IN THE LINE OF BATTLE. Prize Essay, 1896. By Lieutenant A. P. Niblack, U. S. N., ... 1

Discussion:

Commander C. F. Goodrich, U. S. N., 28.—Lieutenant John M. Ellicott, U. S. N., 30.—Lieutenant Wm. F. Fullam, U. S. N., 32.—Lieutenant Spencer S. Wood, U. S. N., 34.—Lieut.-Comdr. Richard Wainwright, U. S. N., 37.—Lieutenant R. C. Smith, U. S. N., 38.—Rear-Admiral S. B. Luce, U. S. N., 43.—Lieutenant A. A. Ackerman, U. S. N., 48.—Ensign Philip Andrews, U. S. N., 55.—Captain H. C. Taylor, U. S. N., 58.

SPEED CONTROL IN MODERN STEAMERS. By Lieutenant M. L. Wood, U. S. N., ... 61

A SYSTEM OF AIMING DRILL. By Ensign Philip Andrews, U. S. N., . . 79

THE ORGANIZATION, TRAINING, AND DISCIPLINE OF THE NAVY PERSONNEL AS VIEWED FROM THE SHIP. Honorably Mentioned. By Lieutenant Wm. F. Fullam, U. S. N., ... 83

Discussion:

Captain R. D. Evans, U. S. N., 116.—Commander J. B. Coghlan, U. S. N., 119.—Lieut.-Comdr. W. J. Barnette, U. S. N., 124.—Ensign Philip Andrews, U. S. N., 125.—Ensign T. P. Magruder, U. S. N., 126.—Commander F. E. Chadwick, U. S. N., 127.—Commander C. H. Davis, U. S. N., 131.—Lieutenant W. H. Halsey, U. S. N., 133.—Lieutenant J. M. Bowyer, U. S. N., 136.—Lieutenant A. L. Key, U. S. N., 137.—Commander Chas. M. Thomas, U. S. N., 138.—Lieutenant H. S. Knapp, U. S. N., 139.—Lieutenant F. J. Haeseler, U. S. N., 141.—Commander C. F. Goodrich, U. S. N., 143.—Lieutenant F. K. Hill, U. S. N., 147.—Lieutenant Harry P. Huse, U. S. N., 149.—Ensign W. W. Phelps, U. S. N., 152.—Lieutenant J. M. Ellicott, U. S. N., 152.—Lieutenant Bradley A. Fiske, U. S. N., 156.—Lieut.-Comdr. Richard Wainwright, U. S. N., 156.—Lieutenant A. P. Niblack, U. S. N., 158.—Lieutenant G. B. Harber, U. S. N., 160.—Lieutenant Albert Gleaves, U. S. N., 160.—1st Lieutenant Charles A. Doyen, U. S. Marine Corps, 160.—Lieutenant C. S. Richman, U. S. N., 168.—Lieutenant C. E. Colahan, U. S. N., 169.—Commander W. M. Folger, U. S. N., 170.—Commander J. N. Hemphill, U. S. N., 171.—Commander C. C. Todd, U. S. N., 172.—Captain P. F. Harrington, U. S. N., 173.—Lieut.-Comdr. Uriel Sebree, U. S. N., 178.—Rear-Admiral S. B. Luce, U. S. N., 180.—Lieutenant H. C. Poundstone, U. S. N., 183.—Lieutenant C. H. Lauchheimer, U. S. M. C., 184.

NAVAL WAR COLLEGE. By Captain H. C. Taylor, U. S. N., President of Naval War College, ... 199

PROFESSIONAL NOTES, ... 209

Sights for Ordnance.—Device for Minimizing the Effects of Collisions at Sea.—Improvement in War Material.—Modern Projectiles, by V. G.—The Training of French Naval Officers.—Cordite.—Electric Training Gear.—Silent Setting-Up Drill.—Ships of War.

BOOK NOTICES, ... 245

BIBLIOGRAPHIC NOTES, ... 247

ANNUAL REPORT OF THE SECRETARY AND TREASURER OF THE U. S. NAVAL INSTITUTE, ... 261

OFFICERS OF THE INSTITUTE, ... 265

PRIZE ESSAY NOTICE. ADVERTISEMENTS.

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PRIZE ESSAY, 1896.

MOTTO: "In making these recommendations I am fully alive to the full responsibility incurred, and keenly realize all the consequences that may follow."—*President's Message, Dec. 17th, 1895.*

THE TACTICS OF SHIPS IN THE LINE OF BATTLE.

BY LIEUTENANT A. P. NIBLACK, U. S. Navy.

Tactical deductions from the few modern fleet engagements under steam are in the main inconclusive and unconvincing. Relying, therefore, on purely theoretical considerations, no well-established general principles and rules can as yet be said to have been satisfactorily formulated or generally accepted. A consistent scheme of tactics is, after all, more or less a series of guesses at the truth, and it would seem that the active discussion of tactical problems by the many interested is the only hope of approximating the theory to the probable conditions of battle.

Many systems of naval tactics which have been proposed have failed of acceptance through the illogical assumption that any advantageous or clever offensive or defensive group formation is the certain key to victory under all circumstances. Analogies have been tried by which a system based on army tactics has seemed to offer a definite solution. It is safe to say that no

general scheme can ignore the importance of the study of every possible movement and formation which it is in the power of a hostile fleet to take either offensively or defensively. Such study will show that a false move may give the deciding advantage to an opponent, and that the chances of victory are with the side which makes the fewest mistakes. It may seem that this view makes fleet tactics very much like a game of checkers, in which each move on the board has a corresponding move which carries with it an advantage, and that a fleet engagement must be a series of moves and counter-moves. Up to a certain point this is undoubtedly true. The problem is really to deduce rules of movement and counter-movement, under varying conditions, and thus give definiteness to the formulation of the fundamental principles of fleet tactics. After all, the stern test of war may find any theory wanting, but, for all that, a fleet has an immense initial advantage if its officers recognize certain rules as imperative under given conditions. If this is not really feasible, it at least reduces the necessity of signaling to a minimum, and that is much to be desired.

As applied to troops or large masses made up of different arms, the term grand tactics is generally accepted as meaning the handling of an army in the presence or in the immediate neighborhood of an enemy. When applied to small bodies or single arms, such as cavalry, artillery, or infantry, it is called minor tactics. A fleet being made up of vessels of various types and classes, it may be said that in considering the handling of ships in the line of battle as here advocated, and to which this paper is restricted, we are really dealing with minor naval tactics. One must be very bold indeed to propose a scheme of grand naval tactics embracing the details for manœuvring a great fleet made up of battleships, rams, cruisers, gunboats, colliers, supply ships, tenders, scouts, torpedo cruisers, torpedo boats, torpedo-dépôt ships, repair ships, and sometimes troop ships—in fact, a fleet of ships comprising the line of battle with auxiliaries and *impedimenta*—yet some one must undertake it some day and execute it somehow.

Tactical Considerations.

The study of naval tactics has not kept pace with the advance in *materiel*, and if we can satisfactorily outline the principles

which should govern the vessels in the line of battle we shall have made a great step towards the solution of the other questions involved in grand tactics.

Tactics must embrace a consideration of fleet manœuvres in the presence of the enemy, both in battle and in retreat. It will simplify this discussion very much if we consider simply battle-ships and cruisers in their relation to the fighting line, and regard our own and not foreign ships as the types under discussion.

The elements which we are called upon to consider are the three weapons of the fighting line, the gun, ram, and torpedo. We must also give consideration to the relative values of speed, quick turning powers, subdivision of the ship, and armored protection, as affecting tactics.

As all men-of-war are built primarily to carry guns, the question of armor protection against gun fire is conversely of prime importance. A modern ship with a protective deck, when broadside to the fire of an enemy *at long range*, is in less danger from the plunging fire of shot and shell striking inboard than if she were bows on, because of the better deflection of the deck, and the fact that when bows on the danger zone is the length of the ship, whereas in broadside it is the breadth. As ships must approach bows on, or else never get within range of one another, the *chances* are equal in hostile squadrons in the matter of this danger from plunging fire at long distance, but the advantage is with the fleet which brings the greater number of *heavy* guns to bear. The target being smaller in the bow presentation, and the chances of hitting at long distances not so great, this phase of the armor question takes on another view when we consider that at close range the above conditions are reversed in ships of the line; for a battle-ship of to-day *at close range* is defensively stronger in bow presentation than in any other, for her deflective deck is not threatened by plunging fire, and her armor offers then its least area, best deflective angle, and its greatest concentration. Importance is here given to plunging fire because the vital parts of a ship are below the protective deck, and as long as these vitals are uninjured it would seem impossible under normal conditions to annihilate or place a ship out of action by gun fire alone. Destruction is the function of the torpedo and the ram. Speed, turning power, and great subdivision are

the defensive means by which these dangers are minimized. In fleet engagements, gun fire is the necessary preliminary to the use of the other two weapons, the ram and the torpedo.

Once in the range of the enemy's guns in a fleet engagement, questions of speed and of turning power are important in the ability given, by superiority in these respects, to take and maintain a position of advantage, or to get out of a position of disadvantage. Individually, they imply ability to ram or avoid ramming, but in fleet engagements it must always be borne in mind that the tactics of the fleet is primarily the tactics of the gun.

The installment of heavy guns in pairs near the ends of a ship has grown up as an incidental result of a consideration of the distribution of weights, but also through the facts that: 1st, a gun on the middle line of a ship which can be fired across the deck is under most circumstances equivalent to two guns, one on each side; and, 2d, a pair of guns in a single turret can be given the same armor protection on two-thirds the weight required to install them singly. This contributes largely to the increase of armor protection in the bows-on position. It is claimed by some advocates of the ram that this strengthening of the bow presentation of a modern armored ship is in deference to the power of this weapon. At any rate, with steam, ram or no ram, the approach to an enemy must necessarily be bows on whatever the ships have been designed for, and clearly we will get very much adrift in the discussion if we fail to realize how the modern changes in ship construction have necessarily entailed changes in the sailing frigate tactics of the days of Paul Hoste and Clerk. The danger from an old-time raking fire at close quarters is now changed into a position defensively of advantage. The supreme object in early days was the close-hauled line ahead (column) with the weather gauge—close hauled (or a course near the wind) because this was the only way to keep the advantage, and the weather gauge, because the position to windward gave the power to choose the time and distance for the attack, and gave the disadvantage of smoke to the enemy. Column being safe and easy to maintain, it was natural that broadside fire should be all-important, particularly as the form of the ship and the details of construction practically made bow and stern fire inconsiderable at best. It thus came about, in the sailing-ship days, that *guns* were in line only when ships were in column, but this is only one

phase of the question now. With steam has returned the old weapon of the galley period, the ram, and with modern ship construction heavy bow and stern fire are possible. Modern conditions demand modern tactics.

Bow fire is now a considerable factor; the ram has its subsidiary tactics; armor has nullified the danger from raking fire at close quarters; the torpedo has made it dangerous to fight at close quarters; smokeless powder and high speed, using any powders, have minimized the embarrassments of smoke in the leeward position; and elaborate subdivision in ships tends to prolong and increase the difficulties of the destruction of ships by either the gun, the ram, or the torpedo.

In outlining a modern scheme of minor naval tactics of ships in the line of battle, it will be well to first inquire what class of ships should compose the fighting line. As the battle-ships or coast-defense vessels must be accompanied by scouts, cruisers, and possibly by rams (if this type of ship is persisted in), the fighting line must embrace all of these types. Ignoring the question of the *impedimenta*, and endeavoring to keep in mind clearly that only the ships built fundamentally for fighting are under consideration, the formations and dispositions chosen for battle should assign the brunt of the fighting to the armored ships, and leave the rams and protected and partially protected cruisers either in the second line or in the reserve, close at hand, ready to be called into action and relying on their speed and handiness to avoid dangerous contact, except when supported by the heavy ships. All this may sound vague, but will be treated in detail later.

Before taking up the question of what formations are best for attack or defense under varying conditions, to prevent the writer from being convicted of error on a misunderstanding of terms, to give definite and technical value to statements, and to limit the discussion to the real issues of the problem, it will be absolutely necessary to give a few definitions taken from the standard works on naval tactics as accepted in this country.

Definitions.

1. In army tactics the *strategic front* is the line joining the actual positions occupied by the masses of an army. In naval

tactics it may be taken to represent the breadth, or sea room, occupied from one extreme flank to the other, measured at right angles to the line of bearing of the enemy. The depth of a formation is the distance from front to rear.

2. Captain Hoff, in "Elementary Naval Tactics," says, "Fighting formations all come within one of the four following categories:

(a) Narrow front—great depth.
(b) Extended front—slight depth.
(c) Front and depth equal.
(d) Groups."

Tacticians have given us the terms *direct* and *rectangular* as applying to fleet movements.

3. By *direct* movements vessels keep within a certain number of points of the original course and reach their new position in a change of formation practically at will, though really, in our navy, by prescribed rules as to variations in helm and speed, and with an oblique limited to three points from the original course. As most direct movements are made by obliquing, it would be quite as accurate to call them oblique movements, although, under any name, it should be noted that from the time the ships break the old formation until the new one is completed they are in no formation at all, and collisions are liable to occur unless great precautions are taken. The real theory of direct movements is that the ships always present their rams to the enemy.

4. By *rectangular* movements a fleet theoretically goes from one formation to another by a series of simultaneous and successive movements, in which each ship performs the same evolution at undiminished speed, and in which the course and distance passed over are ultimately the same for each vessel. As some rectangular movements are 45° instead of 90°, it would be just as accurate to call them either angular or successive movements, but, under any name, in manœuvring in the presence of the enemy, this method has the apparent drawback that, by it, broadsides are exposed to the enemy's line of rams.

The direct (oblique) method suffers by comparison with the rectangular (angular or successive) method, as will be seen by the following comparison taken from Hoff's "Elementary Naval Tactics": "If there was a force of ships in column, and line was directed to be formed, the direct evolution with eight ships and

at a standard speed of eleven knots would only be completed two miles from where the evolution began, and would take twenty minutes. If the rectangular method was used, the evolution would be accomplished in eleven minutes, and only eight hundred feet ahead of the point where the evolution started." If reserve speed were used in the direct method the evolution would be performed more quickly, but as this is equally true of the rectangular, it does not vitiate the illustration.

5. Some tacticians assert that once in the presence of the enemy, in any formation, simultaneous movements, that is, change of heading of all ships simultaneously, are the only ones that can be used in action. In this view, naval tactics consist in selecting some strong offensive or defensive formation, group or otherwise, and sticking to it. It is the standard argument of most advocates of either symmetrical or unsymmetrical group formations. But it is in the main simpler to regard group formations as a separate question, discussing it as such, and *to consider simultaneous movements as one phase of the rectangular.* This separation of the issues clearly between the direct and rectangular movements, without complicating it with the group question, is important and necessary, and will here be followed.

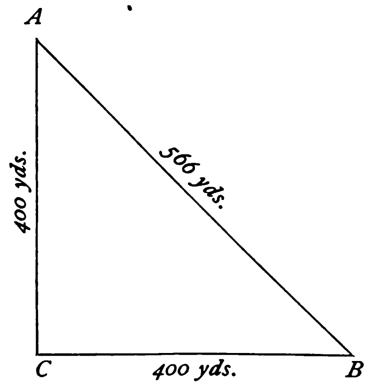
The following illustration will show the embarrassment of using direct in combination with rectangular movements:

Distance between vessels being in our present tactics 400 yards in line or column, and 566 yards in échelon, if there are six vessels in échelon and either line or column is formed by a half-turn, all vessels must readjust to 400 yards on the leader or guide, requiring the rear, or off guide vessel, to regain 830 yards. Being in line or column, if vessels half-turn, échelon is formed, but the distance is 400 yards instead of 566 yards. If order is now given forward into line, the distance would only be (in line) 283 yards. These readjustments are confusing, and should not be thought of in the face of the enemy.

To point out some practical embarrassments with direct movements *per se* with distance of 400 yards, let us take the extreme case, the Columbia, or Minneapolis, and state the case in every way in the extreme.

Let us assume the Minneapolis and Columbia as being in section in line and signal made to form column, left vessel forward, right vessel left oblique. Let us further assume that the

putting over of the helm does not slow the right vessel appreciably. If the oblique is made four points, the distance to be traversed by one ship is relatively 566 yards to the other's 400 yards. On the completion of the manœuvre, the distance from center of *A* to center of *C* is only 566 — 400 = 166 yards or 498 feet. As each ship is 412 feet long, and distance is measured from center to center, it will be seen that from the stern of the Minneapolis to the bow of the Columbia there will be just 86 feet to spare.



Our present tactics prescribes that *B* shall slow to two-thirds speed as she puts her helm over to oblique 3 points, but as, even if you *stop* the engines, a ship carries her way with her original speed some four ship's lengths, it happens practically that *B* comes uncomfortably near *A*, and, where there are four or six other ships, the error is cumulative. It takes a very great amount of drill to make the execution of direct methods other than ragged and unsatisfactory. The fact is, the standard distance should vary to suit the particular division, squadron, or fleet, but should not vary for any particular formation. As massed formations require that ships should be as close to one another as feasible, this distance should be what is required to manœuvre with safety and *no more.*

If it is necessary to form échelon to the front or rear by the direct method, vessels should oblique in to standard distance from center to center, because you are then in position to form line or column, and you have regained distance while changing line of bearing. In other words you have minimized the evil of changing bearing in the face of the enemy by readjusting all derangements. Conversely, if in échelon and line is formed to the front, ships should open out to standard distance as they advance to come in line.

The advantages of rectangular methods are as follows:

(a) Each ship executes simultaneously or successively, identically the *same* manœuvre, at *same* speed, and with *same* effective helm.

(b) The wake of the next ahead is always clearly marked on the surface of the water, whether or not the ship is visible, so that following is easy even in thick smoke. By towing a sentinel astern on a distance line, all danger of collision is minimized.

(c) Ships are the least possible time out of a distinct formation, and are always on one or, at most, two definite lines of bearing. The change of bearing is successive and definite, so that there is no uncertainty, and no danger arising from uncertainty.

(d) Rectangular movements require fewer signals than direct movements, and, in the absence of signals, most of them can be executed by following the movements of the leader, or flagship.

(e) This method is the best for manœuvring mixed types of ships of different tactical values.

(f) It permits of massed formations with the least manœuvring area for safety. The direct movements are dangerous in smoke, bring a great strain on the mind of the commanding officer, and make the next astern often of more danger than the enemy.

Some direct movements, such as échelon from line (and *conversely*) are, however, performed more quickly than by the rectangular, and besides do not lose sea room on the flank; but from actual trial in twelve tactical games at the War College the past summer, war conditions being simulated as nearly as practicable, 84 per cent. of all manœuvres were simultaneous or successive *changes of direction* principally in column, while only 16 per cent. were devoted to all other formations (such as changing front, forming double column, échelon, etc.).

After all, the limitation of tactical manœuvres to certain definite methods limits also the number of signals for battle purposes, and this is much to be desired.

6. Foreign books on tactics, on which all of our own are based, use terms to express formations which we must either use, or else state the equivalent for, in order to give definiteness to statements.

Column is here taken to mean "line ahead." Abroad, a column is any distinct group in any formation.

"Line abreast" is simply *line*.

"Bow" or "quarter line" is *single échelon*.

"Double bow" or "double quarter line" is *double échelon*.

7. The word *standard*, as applied to helm, speed, or turning circles, in our navy, implies that to make all ships of a fleet homo-

geneous, or of equal value tactically, all must conform to the capabilities of, and perform the same as the least effective ship in the fleet. Hence such terms as "standard full speed," "standard helm," etc.

Tactical Propositions.

Definitions having been given in order to insure accuracy of statement, the point of view and the guiding principles on which the rules of action are based should be clearly stated.

The object of all manœuvres in a fleet action is to get and keep the enemy within effective range; to blank some of his gun fire by getting a superior position; to hold an advantage gained, or, losing it, to manœuvre for a fresh one; to avoid waste of ammunition; to concentrate fire on an exposed flank of the enemy in order to reduce the tactical efficiency of all ships by crippling one or more; but, of all things, at all times, to keep up an effective and destructive fire.

To expand this general proposition, the following special ones are here enunciated as the principles on which any scheme of steam fleet battle tactics must be developed. They may not all be incontrovertible. On the contrary, they may be unconsciously inaccurate and only true in part. If so, they at least serve the purpose of forming a basis for discussion.

1st. As many methods of interior communication should be available in each ship as will enable her commanding officer to handle her effectively.

The four things which he should have under his complete control are (1) the speed, (2) the course, (3) the gun fire, and (4) the torpedo fire. The things which he ought to know at all times, or be able to obtain by proper interior communication, are (1) the helm angle, (2) the revolutions of the engines, (3) the range of the enemy, (4) the distance and bearing of the guide in squadron, (5) the readiness of each division of the battery to fire, (6) the readiness of each torpedo-tube to fire, (7) the intactness of the hull, and (8) the heeling of the ship.

2d. Signaling between ships is merely a means to an end, and, while this end can be attained with the minimum of signaling by perfecting the rules of tactics, yet every known method of signaling between ships should be available for battle, so that if one,

fails another may be used. The virtue is not so much in any *one* method as it is in having many.

This includes reeving of numerous halliards, developing shape signaling, adopting some form of semaphore, perfecting day fireworks, using some form of siren, or whistle, with cone reflector, and some form of steam jet in the armored tops to make visible steam puffs, etc.

3d. Protecting shields and armored fighting stations at several points should be provided for the admiral, the captain, the signalmen, and the immediate officers liable to succeed to the command in case of accident to the commanding officer.

These latter, the executive and navigator, should be separated somewhat to avoid danger of being killed or injured simultaneously, and should keep the captain posted as to the progress of events and as to signals made.

4th. Every known device for obtaining the range of the enemy and for aiding in keeping position in formation should be available. Range-finders, sextants, trial-shots, telemeters, stadimeters, and estimating distances should be resorted to as occasion demands.

5th. Everything should be done that is possible to take certain details off of the mind of the commanding officer in action. Battle signals should be few and simple, corresponding to few and well-understood movements. Tactical rules should be established whereby, in the absence of signals, a certain logical and definite course of action may be pursued. Gun fire and torpedo fire should be regulated by hard and fast rules, so that those in charge may act intelligently, but both should be under the control of the commanding officer, *to avoid waste and to prevent injuring friends*. The ram is absolutely under his control, because ramming is a question of helm and speed, and on him alone rests the awful responsibility for risking the use of this, the most dreadful weapon known to modern warfare.

6th. As far as practicable, all movements during battle should be rectangular, at standard speed, standard distance, and with standard helm.

7th. Tactical distance, here defined as *standard* distance, should be the radius of the standard turning circle of the particular fleet or squadron, and not an arbitrary number of yards for all squadrons.

8th. The speed in battle should be standard fast speed. Stan-

dard full speed and individual full speed should be reserved for emergencies.

Speed is not a weapon. Superior speed is the means by which one of the three weapons of the line of battle may attain and keep a superior position or secure an advantage. A reserve speed enables a fleet to seize a given advantage when it offers, or get out of a position of disadvantage.

9th. In a fleet action the tactics of the torpedo and the ram are incidental to the tactics of the gun, which is the weapon of prime importance.

This assertion is too fundamental to admit of discussion in the limits of this paper.

10th. Tactical rules apply only to a given relation, temporary or otherwise, between two opposing fleets. An advantage gained by a skilled manœuvre may be lost by a counter-manœuvre of the enemy, and can only be held, or regained, by either superior speed or superior skill.

11th. Direct movements in changing formations serve an occasional purpose only, and their use should be limited to bare necessity.

12th. If the direct method of forming échelon is used for any purpose, ships should be required to close up to standard distance from center to center, in order to be ready, if necessary, for a change of formation by the rectangular method.

13th. Any long extended order, whether line or column, is fundamentally weak (Captain H. C. Taylor, U. S. Navy).

14th. There is nothing in modern gun fire to deter an admiral from adopting any formation however compact for his advance upon an enemy (same authority, Captain Taylor).

15th. Massed formations are fatal to passive defense, but of the utmost value for vigorous offense (same authcrity).

16th. Group formations for battle, as distinguished from massed formations, should be limited in use to giving mutual support at critical times, otherwise some form of line, column, or échelon should be the formation.

To justify the arrangement of ships in groups, there must be some advantage attained by it in gun fire, ramming, or in mutual support. All group formations which are not flexible enough to admit of readily passing into simpler formation, such as groups in column, line, or échelon, should be condemned at once. Most

of those which have been proposed have been of three or four vessels disposed at the angles of triangles or parallelograms, it being claimed that signals are thus seen more plainly, the vessels give mutual support, and changes of direction simultaneously do not alter the figure. The groups are formed in line of groups, column of groups, and échelon of groups, so it is important to inquire whether groups thus arranged are more advantageous than single ships. In the first place, it is utterly outside of the discussion to claim that groups are a good cruising formation. We are considering battle tactics. We can dispose of the group of four at once by considering it made up of two groups of two each, so we will consider two against three. The *péloton* is the favorite three group. Ships in line, column, or échelon of pélotons, take up much more sea room and are less compact by one ship for every group than a formation in indented line, column, or échelon, of the same strategic front. If nothing else were needed, this defect of want of compactness would condemn it. Captain Hoff points out most conclusively in all he has written on the subject, that the section of two vessels is the group of greatest mutual support, "where, in line, the gun and ram of one support the gun and ram of the other; and, when formed in column of sections, the guns of the leader support the rear vessel, and where the rear vessel supports the leader with its ram." This section of two is flexible. It is always either tentatively formed, or in position to be formed by a slight movement of the helm, or a change of speed. For instance, in double line, if the second line closes up to standard distance on the first, the formation is really "column of sections disposed in line abreast." In indented line, each ship which is to the rear, by moving its helm, can sheer into the wake of its leader, and we have the same formation as that just stated. Indeed, any other group formation than the section of two ships is a step backwards.

17th. The manœuvring power of a squadron being that of its least efficient ship, tactics should, by judicious formations, aim (a) defensively to preserve the integrity of its units, and (b) offensively to reduce the tactical efficiency of the enemy by concentrating the attack on one or more of the units of his fleet, particularly on the flank, or on a manifestly weak part of his formation.

18th. In manœuvring to concentrate on a part of the enemy's formation, the secondary object of all movements should be to gain an advantage, temporary or otherwise, of your gun fire over that of the enemy by blanking as much of his gun fire as possible.

19th. Concentration may be accomplished by enveloping a portion of the enemy's fleet, but concentration should always be accompanied by constriction and with a full knowledge of its dangers (Captain H. C. Taylor, U. S. N.).

Concentration is either by gun fire or by rams. Neither has much application in the early stages of an action where the manœuvring power is such that gun fire alone will hardly cripple a vessel to a standstill. According to Captain Hoff, concentration by rams means the "causing of a ship attacked to steer a course as divergent as possible from the general course steered by the rest of the ships of the force to which she belongs, and thus cut her off from her consorts."

20th. Echelon is a strong defensive formation, but may be dangerous to the fleet using it, unless superior in speed to the opponent. As a formation for attack, it is too oblique to the line of bearing of the enemy. As a means of concentration of gun fire on the head or rear of a column it is excellent.

If attacked on the flank in the direction of its line of bearing, the fire of all the ships on that bearing is blanked. When thus attacked it is a difficult formation to get out of except by a direct movement, and then the ships interfere with one another's broadside fire just when it is most needed. Echelon is really the compromise between line and column, with the disadvantages of both, for it is as difficult to maintain as line, and not so flexible as column. Vice-Admiral Randolph, R. N., proposes, in *Problems in Naval Tactics*, a sort of line-échelon formation for attack in which the line of bearing is 17°. In torpedo-boat tactics abroad, the groups steam in overlapping column, each bearing about 17° on the quarter of the other. This is a variation of column towards line. Echelon is really a tentative formation for a special purpose, as illustrated in No. 30. As a continuous battle formation, it has ceased to have many advocates. Therefore, some form of line and some form of column are the remaining ones to be considered.

21st. The reserve, made up of special ships, has its special tactics, not here considered, as they must act independently and manœuvre to avoid action until such time as they may relieve

a weak position, or consummate the advantage obtained by a strong one.

22d. The flagship in a small fleet should be a battle-ship of the heaviest order, to be able to lead when necessary and bear the brunt of the approach in a manœuvre.

23d. The flagship in a large fleet should be an armored cruiser of considerable speed. Her position need not be in the line of battle except when it is to her advantage.

She should be accompanied by a second armored, or a protected, cruiser as a mate, and these two vessels should manœuvre as an independent section, or group of two. They may, or may not, be accompanied by two or more torpedo cruisers to serve as dispatch vessels, and also for defensive purposes, in event of a concentrated attack by the enemy on the flagship. The admiral should be in an armored cruiser, in a large fleet action, because of her speed and protection, and should be independent of the formation, that others may easily see his signals, and to enable him to see as much of the action as possible.

24th. Under average conditions, the best initial formation for the approach to the attack is *line in some form or other*. If the enemy is not in line also, and a charge through is not practicable, column will probably be used until a charge through, line to line, can be forced on the enemy.

This proposition will be argued at length later on.

25th. Line should be limited to a front of eight vessels, as that is the maximum that can be brought into action *and preserve flexibility* enough to pass readily into column.

With twelve ships, in double line, six in each line would be better. If the enemy is in line and presents a broader line, the flanks should be strengthened by a heavy ship in column of section with, and in rear of, each flank ship. Distance between lines in double line should be not more than six cables, that being proper supporting distance and inside the limit of time of loading and firing big guns in a charge through.

26th. Column is historically and logically the strongest formation, but should never be used for the approach to the attack unless the fleet using it has the advantage in speed. Once in the zone of fire, and the charge through not expedient or practicable, column is the safest, best, and most effective formation to go into from line.

27th. Column should always be taken to mean *indented* column, in which ships do not follow exactly in the wake of the next ahead, but a little on the port and starboard quarter, alternately, of each ship.

This minimizes the danger of collision, enables a more compact formation to be maintained, permits signals to be seen to better advantage, places the ram of the mate to better advantage in case of need, and best gives to column all the advantages claimed for it, viz.:

(a) Column is easiest to keep or to reassemble in.

(b) It is perfectly flexible, and can, in a few minutes, change to any direction and into other formations.

(c) Each ship is flanked by the two next astern, which can come up on either side in case of need.

(d) Ships in column can maintain the same speed.

(e) By a slight sheer out of line, any or all the weapons—the gun, ram, or torpedo—can be called into play.

(f) In this formation guns practically are in line.

(g) The indented column is more *adhesive* and concentrated than direct line ahead (column).

28th. The changes of direction of head of all ships simultaneously, or of head of column in action, should be four points, or multiples of that number.

This enables us to reduce the number of battle signals; it simplifies movements; it adds to the effectiveness of gun fire by not changing direction so often; and it prevents a wavering policy as to converging on the enemy. In rounding the flank or rear of an enemy's formation, an exception to the above will be made in that each will circle and draw in without regard to four points and without the necessity for signals, as hereafter described.

29th. Chase should always be given where opportunity offers, viz., when the enemy offers a stern presentation. Unless he is superior in speed he cannot get room to turn and front you when you are once close in his wake, and you can pick up all stragglers.

30th. A greatly inferior fleet in point of numbers, but possessing a decided advantage in speed, may attack a column with some show of success by the retreat formation in double échelon.

31st. A greatly inferior fleet in point of numbers, or in types

of ships, should seek to bring on an engagement, if at all, in narrow waters well known to its officers.

The preceding propositions may all be summed up in the following phrases: 1. Massed formations. 2. Concentration in attack. 3. Reserve speed. 4. Knowledge of plans. 5. Ability to execute them. Further arguments in support of several of the more important propositions will appear in the discussion of the fleet in action.

Until we know a little more about tactics, the most practical method of arriving at sound conclusions is to analyze the gun fire and tactical qualities of the ships we have, and deduce tactics to fit them. We do not know the tactical qualities of many of the newer ships, and it is not good policy to publish the tactical data of those now in commission. Fortunately, gun fire alone gives very conclusive results from its study.

Prof. Alger, U. S. Navy, in a recent lecture at the War College, gave an illustration of the broadside fire of battle-ship No. 5 (Kearsarge), in which it was assumed that a 13-inch gun can be fired once every 5 minutes, an 8-inch once every 2 minutes, a 5-inch R. F. three times in 1 minute, and 4-inch and smaller calibers four times in 1 minute: "We find that of the whole number of projectiles fired in any period of time on one broadside, only six-tenths of 1 per cent. will be 13-inch, 1.6 per cent. of 8-inch, 16.5 per cent. of 5-inch, and 81.3 per cent. of the smaller calibers. In other words, 3-inch armor will keep out at least 81.3 per cent. of all projectiles fired by one battle-ship against another, 6-inch armor will keep out at least 98 per cent., and 12-inch armor at least 99.4 per cent. When we consider the fact that most impacts will not be normal, and that the range will usually be considerable, we may safely say that under any probable future conditions armor of 7-inch thickness will keep out 98 per cent. of the whole number of projectiles fired against it."

This view of gun fire does not of course deal directly with the chances of hitting or with the variation in striking energy at different distances. It is an important phase, but there are others.

At the War College, in the tactical games, the unit of gun fire is the broadside fire of a ship, for a certain period of time, at 2000 yards range. The right ahead or right astern fire of a ship under the same conditions is one-half unit; and the bow and quarter fire, three-quarters of a unit. At 4000 yards the values are one-

fourth the above; at 3000 yards, one-half; and at 1000 yards and less, double. Some re-adjustments of the values assigned to right ahead and bow and quarter fire would seem desirable in the light of the accompanying diagrams, which illustrate the values assigned to the different arcs of fire of various well-known ships in our navy, computed on the basis of the percentage of projectiles thrown in any given time, multiplied by the striking energy, 1st, at 2500 yards, and 2d, at 1000 yards. These distances are chosen because the former is just beyond the effective range of all of the secondary battery, and for the further reason that at this range (2500 yards) the "remaining velocity" of a 6-pdr. is just that of a 1-pdr. at 1000 yards. The dotted line represents the value of a single volley from all the guns bearing in the different arcs. It will be noted that *the lengths of the radii, and not the areas of the sectors*, are the measures of the striking energy on any line of bearing. This comparison of the volleys is a good method in considering all the ships, for it ignores any question of rate of fire, which may vary. The full lines are computed on the basis of the number of smaller projectiles thrown in the interval between the fires of the largest caliber gun carried by each ship. The right-ahead and right-astern fire is represented as a sector, it being assumed that a variation in the course of one or two degrees will be permissible in formations to bring the guns to bear.

It is assumed in the diagrams that a 13-inch gun can fire once every 6 minutes, a 12-inch once every 5, a 10-inch every 3, an 8-inch every 2, a 6-inch every 1, a 5-inch R. F. 5 times a minute, and a 4-inch R. F. and smaller calibers 7 times a minute. The rates of fire of the 5-inch R. F. and smaller calibers may be considered excessive, but are based on actual trial. The 13-inch and 12-inch guns in the British Navy are said to fire once every 2 minutes, and even less is claimed. Why our guns should be so much slower remains to be explained.

In comparing the battery power of different ships, as shown by the heavy lines, it will be noted that, for instance, the period shown for the Indiana is 6 minutes, for the Iowa 5 minutes, for the Maine 3 minutes, for the Minneapolis 2 minutes. A comparison of the Minneapolis with the Brooklyn, in which the interval is 2 minutes in both cases, shows clearly where it is advisable to invest money in the future. The assigning of such a slow rate to the big guns and such a high rate to the rapid-fires

emphasizes, probably unduly, in the Kearsarge, the great importance of rapid-fire guns, but it is doubtful after all if we can emphasize this too much. The Puritan is the most powerful of our monitor type. All other monitors would plot the same way as to arcs of gun fire, but with smaller radii. The Monterey would present one slight variation, in that her after turret guns are 10-inch and her forward 12-inch. The Maine shows the effect of the échelon arrangement of her turrets in the strong port bow and starboard quarter fire. The Iowa's stern fire fits her admirably for the rear vessel in a column. The Kearsarge illustrates that, as usual, in departing boldly from European models, we have achieved a notable success. It is to be hoped that some ship of this type will be named the Alabama, to demonstrate that, while the war is over, we should not fail to remember one of its most important lessons.

This analysis of the gun fire of different types emphasizes clearly the fact that each unit vessel of a class should possess the same tactical qualities and the same distribution of gun fire, and that a continuous programme of ship-building should be at once entered upon in conjunction with a thoroughly renovated system of battle tactics, in which the ships should conform to said tactics. The building now of homogeneous ships of a few definite types, and plenty of them, combined with a clear recognition of our future in this hemisphere, is, as even a purely commercial investment, a sound and wise policy, aside from the manifest duty we owe to the coming generations of Americans in perpetuating our free institutions on this side of the Atlantic.

THE FLEET IN ACTION ON THE OPEN SEA.

Having a fleet composed of a certain number of armored ships and a greater number of scouts, protected, and partially protected cruisers, the process by which an action would be brought about with practically an equal force of a worthy enemy would seem to be about as follows:

1st. *Scouting.*—The highest development of the scout would be the improved *St. Louis* merchant type of high speed, great coal capacity, and armored and coal protection to boilers and engines. Her fighting value would be small, possibly, but her capacity for useful work would be in the nature of a revelation. This type

of ship, with an enormous radius of action, would be able to cable or bring in news of the whereabouts of the enemy.

Proceeding in force to look for him, the scouts accompanying the fleet, deployed in extended order, would bring in and transmit by signal the sighting of the enemy in force on a certain bearing, giving such details of his strength and formation as it had been practicable to ascertain. What formation should our fleet at once assume?

2d. *The approach to the attack.*—There is a period of time between the sighting of the enemy and the arrival of the two fleets in the zone of each other's fire which we must carefully study, for on it depends the securing of the first advantage, which often implies that a second will follow if properly managed. During this period the formation to be assumed should be one in which tentatively each ship is in such a position towards the enemy, relatively to her consorts, that her weapons may do effective work at the earliest instant, thereby securing the first advantage. The weapon of great range is the gun. We have seen that "armor of 7-inch thickness will keep out 98 per cent. of the whole number of projectiles fired against it," *at long range*, owing to the fact that impact will not be normal; but we have also seen that a plunging fire of heavy projectiles, striking inboard on the protective deck *in the bows-on position* at long range, possesses the maximum destructive effect which gun fire can produce in *reducing a ship's tactical efficiency.* Therefore, when we ask ourselves in what formation we should approach to the attack, the answer is *that in which the maximum number of heavy guns can be brought to bear at long range, viz., some compound form of line, preferably double line, each line being indented, the heavy ships in the first indented line and the lighter ships in the second indented line, six cables in rear.* This formation is the armed reconnaissance in force preliminary to battle strategy or battle tactics, and in no way commits the fleet to remaining in that formation, because line can at once be changed into column, if desired, as soon as the measure is taken accurately of the enemy's formation and disposition.

In support of indented line formation for the approach to the attack, we may summarize:

(a) It brings all the heavy ships of the first line into the zone of the enemy's fire, and consequently also brings the maximum

number of long-range heavy guns into action *at practically the same moment.*

(b) The second line is protected by the heavy line, and is ready to support it when needed.

(c) It gives a chance to make an armed reconnaissance in force without definitely committing the fleet to any formation.

(d) Indented line can be made compact by using the standard tactical radius for distance from center to center of ships; the group of two is tentatively ready for formation in column of sections; the right-ahead fire of all ships in the first line is unobstructed; the ships in advance in the first line have their broad-on-the-bow fire clear for firing towards the enemy's flanks; and on a simultaneous turn of eight points the line becomes indented column, which is as it should be.

It will be recalled that the flagship, not being in the formation in a large fleet, signals can be seen plainly. In a small fleet the flagship should be on one flank, and should be advanced a ship's length out of line to enable signals to be seen and to act as a general guide.

3d. *The attack.*—It will be a surprise to many to meet with the statement that a charge through, line to line, with the enemy, should be eagerly sought for and tactically striven for. If, in the approach, the enemy is not in line there is no use in remaining long in line, for, if he is in any other formation, column is the best form of attack under most conditions. To remain in line, the enemy being in any other formation, is to invite a concentrated attack on either flank.

Before considering the best method of attacking each separate formation in which we may find the enemy, let us discuss thoroughly the charge through, which is here claimed as the great *desideratum.*

Approaching, line to line, we being in indented line with second indented line six cables in rear, and possibly a third line six cables in rear of that, at 1500 yards from the enemy, or on signal being made, the rear ships of each indented line oblique in one-half point on the quarter of their leaders. This opens a way for the enemy to pass through and removes the danger of a "brush past," or collision bows-on, which is to be equally dreaded by both fleets. If the enemy forms column of sections, in the same way, then the fleets are on equal terms as far as formation is concerned; but if

the enemy approaches or remains in some form of simple or double line, his ships must seek a passage through between our columns of sections. If any one will take the trouble to compute the advantage in gun fire between column of sections and two ships in line abreast, they will readily see what is here implied. In a remote way, column of sections offers, better than any other formation, a possibility for the rear ships of the second or third line to ram any ship of the enemy which may become disabled as it comes through. It will be observed that no mention is here made of torpedo fire. At such close quarters, torpedoes are alike dangerous to friend and foe, which consideration gives to the charge through the additional advantage that it is about the only method of coming to close quarters in which the torpedo is eliminated as a weapon.

The fleet which can reform quickest after a charge through by a turn through 16 points, presenting a renewed compact formation in chase, has an overwhelming advantage.

To those who think that a "charge through" is chimerical, and that no admiral in his right mind would attempt it, it may be answered that if two fleets approach in line, there comes a time, at about 1500 yards, when it will take more nerve to go into column and present broadsides to line of rams than to continue on. Also, if a line attacks a column, both lines of bearing being parallel, it will require more nerve to remain in column than to turn and meet the charge. Any system of tactics based on the impossibility of the charge through must consider tactics simply a duel of guns; for when fleets begin to manœuvre to use the ram or torpedo, close approach, combined with stubbornness, will bring about either collisions or charges through in some form or other.

Tactical Problems.

It is not intended to here formulate definitely the tactical rules which should cover all cases, or which should govern all fleets in action, nor is it intended to illustrate the movements by diagrams. In a fleet which is manœuvred in some compound formation, the method of attack must vary according to circumstances, because the heavier ships must bear the brunt of the fight, and the lighter ships simply act as supports. This paper

would, however, come to a lame and impotent conclusion were some inferences not deduced practically from what has been already said, but, if the tactical propositions are sound, the inferences as to moves and counter-moves can be made by any one. A few simple moves will, nevertheless, illustrate the importance of working out all combinations in detail and outlining the plan of battle beforehand.

To take the simplest formation as an illustration, suppose two hostile squadrons are each in single column, steaming on parallel courses in opposite directions. If the distance which they would pass each other is too great, the aggressive, or A squadron, would, by a simultaneous change of heading, oblique four points towards the other, and, when satisfied with the prospect, would return simultaneously to the original course and stand on. Gun fire being exchanged in approaching and passing, the head of A's column would turn under the stern of B's rear vessel in column at such distance as would avoid his torpedoes, or enable an exchange of torpedo fire to be made. Assuming that the enemy stands on in column, two or three methods of attack by concentration are open to A:

1st. To concentrate fire on the rear ships of B's column as A's column rounds the rear ships, and afterwards to stand on parallel to B's column in chase and concentrate fire on B's rear ships. B can, however, also concentrate on leading ships of A's column.

2d. If A's squadron is superior in speed, it can divide and then double on the rear ships of B's column.

3d. When half-way round the stern of B's column, A's squadron can go into either single or double échelon on the course steered by B, and concentrate fire on B's rear ships.

Before going into an action, the tactical rules laid down by the commander-in-chief should specify which method of attack is to be pursued; also what to do if B's column doubles on the rear ship of A's column at the same time, as a counter-move.

A good illustration of concentration, blanking fire, and giving chase is exemplified in the attack of a line, or column, on a single échelon formation. If two squadrons, A and B, are approaching, A being in line and B in single échelon, A at once goes into column by a simultaneous turn of eight points towards that flank of A which is nearest to (abreast of) B's leading ship. The head of A's column then changes direction four points so as to cross

the line of bearing of B's échelon formation at right angles. After crossing it, A's head of column changes course another four points towards B's squadron, and is then standing on parallel to B's course; the fire of all of B's ships, excepting the leading one (nearest flank), is blanked, while A brings all broadsides to bear in concentration on B's leading (flank) ship. As A's head of column gets well past B's flank, it changes direction eight points, coming in astern of B's ships, and bringing broadside fire to bear against B's stern and quarter fire, then forming line and giving chase by turning eight points towards B, now in retreat.

To illustrate how an adroit tactician may, with an inferior squadron possessing superior speed, attack an enemy's column, suppose A with a few ships in any formation to stand down toward B's column, manœuvring so that he will finally be in line, or double échelon, in retreat, with B's column in chase. A, if in line, can gradually form double échelon, and, by slowing sufficiently, can concentrate on B's leading vessel. Having superior speed, A can avoid action on any terms other than that which is advantageous to him.

To illustrate how to reform after a charge through and immediately give chase, suppose A to have gotten through B's fleet, A being in two or three lines with ships in column of sections disposed in line abreast, eight ships in each line formation: After the rear line gets through (supposing there are three in all), the second and third line go, right wing, head of columns of sections eight points to right, and left wing, head of columns of sections eight points to left. Each wing stands on until clear of the flanks of the first line. (Each wing is in column of four ships.) As soon as clear of the flanks of the first line, each wing of the second and third lines turns simultaneously through eight points, heading away from the first line and towards the enemy, and slows to half-speed. Meanwhile the first line has countermarched by column of sections using port helm, and, standing on at full speed, passes between the wing divisions of the former second and third lines and gives chase to the enemy. As the heavy ships pass, the wing divisions of the other lines successively close in, in the original order, form line, then indented line, and possibly column of sections, according to formation assumed by the heavy ships. It is assumed, in support of this method, that the turn through 16 points is made by the heavy ships better

in column of sections than in any other formation, as there is more sea room, and that the other lines in forming divisions on either flank cover the manœuvre of this line. As the heavy ships stand on, they in turn cover the manœuvres of the supporting lines as they form. Another, and possibly equally good, method is for all columns of sections to countermarch successively, beginning with the first line.

To illustrate the tactics of column to column, standing on in the same direction, we will consider two squadrons, A and B, in single column, with A as the aggressor. There are two conditions to be considered: (a) A faster than B; and (b) A equal in speed to, or slower than B.

(a) A faster than B. A gradually slows and forms double échelon on rear of B's column. If head of B's column turns through 12 or 16 points (countermarches), A, by a simultaneous turn through 8 points, transfers this same formation to concentrate on the head of B's column, turning through *eight points more* in the new (opposite) direction. This is safe enough for A, for, though B is in chase, A can at any time stand on and gain sea room and turn.

(b) A equal in speed to, or slower than B. A slows, and, as each ship brings B's rear ship forward of the beam, it sheers out of column, steering four points towards B so as to come in astern in double échelon formation. If B is faster and draws ahead, A has at least concentrated gun fire as long as possible. As soon as B draws ahead, A forms indented line and continues in chase. A counter-move by B may, on the other hand, make the double échelon formation untenable, as follows: If B's head of column countermarches, or changes direction 12 points, A should at once go into column by a simultaneous change with opposite helm of four points for further wing and twelve points for nearer wing, and then, by head of column the necessary number of points, A comes in astern of B again in line, and can form double échelon once more. It will be observed that in this movement A goes around three sides of a square, or a triangle, according to circumstances, but as column is flexible, it is better than using a direct method.

TACTICAL RULES.

Without intending to outline a consistent system of battle tactics made up of movements and counter-movements in attack and

defense, the following tactical rules are offered as suggestive of expansion by inference and by experience into a general scheme. It should be borne in mind that single line and single column, in fact all simple formations, are much more flexible than compound, but that as eight ships are the limit in even compact formations, we are forced to have compound formations if the fleet is large. In selecting the ships to go in the heavy line, the supporting lines, and the reserve, it will be noted that from the nature of things the supporting line or lines should have greater speed than the heavy line, because the latter manœuvres to come between it (or them) and the enemy, and in going from double line into double column and then changing head of double column eight points, the supporting line must use reserve speed. The reserve should be made up of slow ships and ships of special classes, and, protected by torpedo-boats and torpedo-catchers, should shift for itself and manœuvre to give such support as it can. It is better to go into action with fewer homogeneous ships of good speed and tactical qualities than with more ships when one or two are lame ducks. These last would be better off in the reserve. The fighting line should be agile, and should rely on its heels to be able to protect the reserve in a concentrated attack on it by the enemy. By manœuvring ordinarily at fast speed, the full and reserve speed is kept for emergencies.

1st. When the enemy is sighted, form indented line at right angles to his bearing, with heavy ships in the first line, and advance at fast speed.

2d. If he is in line, seek a charge through in column of sections disposed in line abreast. Torpedoes shall not be used. Gun fire of rear ships shall be reserved for volley firing under control of the captain, so as not to injure friends, until an enemy's ship becomes a target close-to, when general action may be had.

3d. In the charge, to reform after passing through, the first line shall turn with port helm by countermarching in column of sections. The supporting lines shall divide by wings to right and left, eight points, till clear of flank of heavy line, then head towards enemy and slow to half-speed. The heavy line, after countermarching, shall proceed at full speed, the supporting lines coming in in rear and adjusting speed and formation to new requirements. (Another good method is for all columns of sections to countermarch successively, beginning with the first line.)

4th. If enemy is in single échelon, stand across the line of bearing of enemy's formation at right angles in column, then change course to come by successive changes of direction of head of column in rear of his formation, and give chase. If in double échelon, proceed in same manner around either flank.

5th. Always give chase when opportunity offers, because your bow presentation is stronger than his stern presentation; you thus have the advantage in your fire, and while you are in his wake he dares not turn.

6th. In the attack on the head of a column by double échelon, the rear ships of the formation should open out clear of the wake of the enemy's rear ship in column to avoid torpedoes which may be dropped by him in his wake.

7th. The leading ship in a column should never attempt to ram unless it is unavoidable or to prevent being rammed, as it will throw the column into confusion.

8th. If the enemy's column attempts to cut through your column at nearly right angles, either stand on and trust to the rear ships being able to ram or torpedo the enemy; or else (a) turn simultaneously through the necessary number of points to head on same course as enemy, and gradually form double échelon to concentrate; or (b) turn simultaneously as stated and double on head of enemy's column by flank ships forming column by slowing successively.

9th. Gun fire being of prime importance, frequent changes of direction should be avoided as being disconcerting to gun fire. If a fleet is skilled in volley firing, these changes may be made simultaneously to bring certain heavy guns to bear at intervals. The increasing value of rapid-fire guns has, however, weakened the former value of concentrated volley or broadside firing.

10th. Always use rectangular in preference to direct method, unless to serve a special purpose.

As before stated, these rules are founded on the tactical propositions previously enunciated, and do not represent a complete scheme of tactics. One could, and should, be worked out, however, by one or more drill squadrons, or a fleet of steam launches, such as at the Naval Academy, where the practice will undoubtedly develop some flaws in the theories. A set of tactical rules should include both what to do and what not to do. Battle signals will probably be found to be limited to somewhere between

50 and 75. It may be possible, however, to reduce the number to 35 by formulating rules.

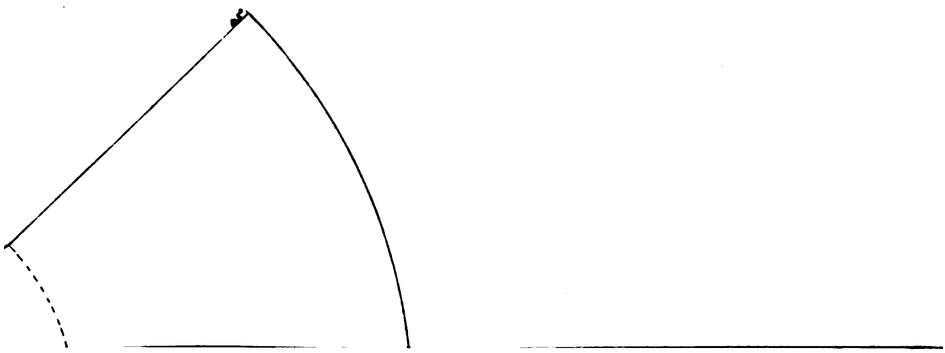
The Naval War College, at Newport, R. I., is accomplishing a great work in formulating the theories of naval warfare. The tactical work should be supplemented by practical exercises afloat. Squadron drill in tactics consists more in studying formations in relation to gun fire with actual target practice, than in making dress parade formations according to inaccurate drawings, based on an inconsistent text which nowhere gives an intelligible idea of the why or wherefore of any formation. Our books on tactics are primers; our signal books are a monument to those who do not go to sea; and the Naval War College, like the proverbial prophet without honor in his own country, is really about our only hope of inspiration in case of that form of national trouble for which alone the Navy has any excuse for existing.

DISCUSSION.

Commander C. F. Goodrich, U. S. N.—The prize essay of this year is a valuable contribution to the literature of naval tactics, quite as much for what it does not attempt as for its positive suggestions.

The form which an action will assume, after once begun, is entirely problematical, although, to my mind at least, it appears highly probable that a general mêlée is an inevitable sequence of the "dash through." If an admiral will, following Nelson's example, take his captains into his confidence, explain his views, invite free discussion, and lay down the result of these conferences in a number of clearly-defined general schemes to cover such actual conditions as are likely to arise, he may be sure that, when the battle has passed beyond the preliminary stage of the attack, when its smoke and confusion have put an end to signalling, and when the casualties, which must be expected, have occurred to prevent further concerted action, he will be only less well served than if he were on board each ship directing its individual manœuvres. For the disorganizing reasons hinted at, it appears wise to consider more particularly the approach, and only to take up the succeeding events as contingent upon emerging from the initial brush with tactical powers reasonably unimpaired.

I am quite at one with the lecturer in believing that, within certain limits, the fewer and the simpler the evolutions for battle the better. Formations offering theoretical advantages, no matter how great, should be ruthlessly discarded if their maintenance makes too heavy a draft on the captain's attention, distracting him from careful study of the enemy



samples. Individually, our ships are admirable. When we group them together their incongruities become manifest. Why not adopt a standard pattern for each class, reproducing the vessels until the logic of progress forces us to recast our scheme in its entirety? There will still remain ample scope for improvement in details without altering principal dimensions, tactical qualities and battery distribution. The essayist is but one among the many who recognize, in the continuance of a mistaken policy, a distinct menace to our fighting power afloat. What we want is a few ships of one kind, not many ships of many kinds. The Institute should speak in no uncertain terms upon this all-important point.

The essayist's mode of attack—line to line—is a surprise to me. It appears to follow as a sequence from an original formation that rules out a notable fraction of one's guns. An admiral so circumstanced must seek to bring his battery into fuller play. The obvious way is to change from line into column. It is conceivable that considerations of the moment may prohibit this manœuvre and impel the dash through with its free use of gun-fire at close range except when exactly abreast of the enemy. A general breaking up into a number of duels between ships seems then unavoidable; still the two lines may pass clean and clear through, barring accidents. This movement appears to involve a surrender of any advantage to be derived from skillful tactical handling, and to trust to luck or superior shooting to get out of the scrimmage with less damage than the adversary. The fleet would, in fact, be used, not as an integer, but as a collection of ships, each having its own separate task. I think that, in practice, neither admiral will venture to hold to the line to the last, so that this particular phase is hardly likely to be assumed by a naval action. If either should keep his fleet so formed he would, I take it, afford the other a delightful opportunity of distinction. In making these observations on the one instance in the essay which, in my opinion, requires further elucidation, I only mean to imply a Scotch verdict and to indicate some of the objections that might be urged against the essayist's position.

In his tactical rules I find nothing to question. The paper is an excellent one. It lays down principles that should govern the handling of ships in the line of battle, and spares the reader a multitude of illustrations which would only confuse and distract. As in our study of trigonometry at the Academy, if we only carry away with us the fundamental equations, their application to any especial problem is never very difficult; so, if our prize essayists give us the broad outlines of any subject as well as Mr. Niblack has done, it will be our own fault if we fail to fill in the necessary details.

Lieutenant JOHN M. ELLICOTT. U. S. N.—I am glad of the opportunity to discuss this essay, having given a good deal of thought to its vitally important yet practically neglected subject.

I think the author attaches undue importance to plunging fire as a tactical consideration at long range. The angle of fall of projectiles at extreme ranges does not exceed 30°, which is much less than their biting

angle, whereas their remaining velocity, already small, will be reduced by obstructed progress to the protective deck. Moreover, the range will change more rapidly with bow presentation than with broadside. In the latter it may be assumed that (if the enemy is allowing for his own speed while sighting) the danger zone is the breadth of your ship, but in the former, with the enemy merely guessing at your speed and attempting to allow for it, the danger zone may be only a fraction of your length, or even *nil*. If you were steaming toward the enemy at ten knots and he had your range at the moment of firing but failed to make allowance for your speed, you would in twenty seconds (a reasonable time of flight for long range) advance 340 feet, or about a battleship's length, and the danger zone would be zero.

The deflection of the protective deck in broadside presentation can scarcely enter in as a measurable factor because of the rolling of the ship; yet if she is rolling much she will, during half the time, present her protective deck to plunging fire at a good angle of impact, whereas she cannot pitch to the same degree and her bow presentation would be safer.

I heartily agree with the author in his remarks about scout vessels, although I think that the scout vessel should be of smaller displacement and greater speed than the St. Louis, and should be a carefully planned and developed type built by the Government, and that there should be plenty of these vessels built.

Tactical rules 1, 4, 5, 7, 9 and 10 proposed by the author seem to me to be sound and excellent ones. Rule 6 should be more a matter of discretion than a rule.

The first part of rule 8 would cause, I believe, a wretched blunder. The head of the column would be for a time out of action, while the rear would probably be cut off and enveloped by the enemy. Alternative (A) in this rule should be the rule, with (B) as a good alternative.

I should not follow rule 2 until I had first tried, by a simultaneous change of course of four points, to reach the enemy's flank. If he were alert he would no doubt make a corresponding change to prevent this, and the "charge through" would become inevitable, but if he held his course even for a very short time I should gain some of the advantage sought. The "charge through" must, however, be promptly accepted against the alternatives of showing a stern presentation or a broadside to a bow, except in a case which I will mention later.

The first method suggested in rule 3 for returning to the attack after charging through strikes me as a bad one. If the enemy adopts similar tactics the two wings of the supports will become for a time engaged in a running broadside fight on opposite courses leading them away from the fighting line, resulting in three separate encounters and ending possibly in a *mêlée*. Granting that the supports will promptly recharge through each other to regain their positions in rear, they will reach them in an unnecessarily crippled condition, and too late to reinforce the fighting lines during the second charge or the next manœuvre. The suggested alternative method is decidedly better, for the supports would then be kept well in hand and could promptly fill gaps in the fighting line made during the first charge.

The condition of the sea may sometimes be a large factor in deciding the tactics of approach, making the weather gauge as desirable now as in the days of sailing ships. With a heavy sea running, a fleet may, by steaming to windward and drawing the adversary in pursuit, cause the sea to seriously handicap him in the handling of his guns, while firing at him to leeward would be easy. No consideration of inferior speed need deter one from attempting this manœuvre in a heavy sea, for while the enemy is overtaking you he will be long enough at a disadvantage to be considerably injured.

Although concentration with the ram may often be advantageously threatened, its actual use should be limited to special opportunity, and even then a commanding officer must weigh his individual opportunity against the danger of confusing a squadron or fleet manœuvre. Torpedoes should be largely husbanded to give the *coup de grâce* to a crippled adversary. They are almost certain weapons of destruction against a vessel whose steering gear or motive power has been even temporarily disabled, while their use in the fighting line is little better than mere gambling. I speak of the weapon in its present development. Tactics should especially contemplate the detachment of vessels from the support to give the *coup de grâce* to disabled adversaries, or to interfere for the protection of one's own vessels in temporary distress.

Another important point to consider in tactics is that a battleship, while still intact in hull, motive power and the major portion of her battery, may be fought to a standstill by the destruction of her battery personnel. Would it not be well to have swift vessels in the reserve with fresh crews for replenishment in such an emergency, and to have some tactical emergency plan for the rehabilitation of such a battleship?

The closing paragraph in the essay might well have been printed in italics and emphasized in every other known way.

Lieutenant WM. F. FULLAM, U. S. N.—The prize essay this year is very timely. The Fleet Drill Book needs immediate revision, and the principles laid down by Mr. Niblack form a good basis for the work. Officers have had enough experience now to enable them to improve upon the present book. Improvement should not be delayed on the ground that perfection is not yet possible. We should at least make some little progress from year to year. Otherwise officers will become very much discouraged and will see little reward in devoting their time and energy to the subject. It is a trifling expense to print a few copies of a drill book, and there should be frequent revisions in order that officers may see the result of their work. In this way there would be steady improvement and a better chance of ultimate perfection than by delaying revision and postponing action.

In the limited space permissible, it will not be possible to note all the points in Mr. Niblack's admirable paper. His arguments against "direct" movements and in favor of "rectangular" and "simultaneous" movements are sound. On paper the "direct" movement looks well. The word "direct" has a winning sound. As in infantry tactics, officers were inclined to choose the system of moving by the shortest line.

But when a squadron engages in manœuvres the objections to oblique movements are soon discovered. Even with a large staff of assistants with stadimeters, etc., and a clear view from the bridge, with no noise and all conditions of the dress-parade order, the officer-of-the-deck finds it difficult to execute direct movements with precision and success. And even after constant repetition the improvement in performing such movements has been so slight as to be hardly noticeable. Evidently, then, a captain alone in the conning-tower, with a hundred things to think about, will find the execution of such evolutions very difficult.

Variations of speed introduce the principal element of trouble in fleet evolutions. If, in action, a certain speed is decided upon and maintained throughout by using rectangular and simultaneous movements, a captain might keep his ship in position, approximately at least, even if all telegraphs and every means of communication between the conning-tower and the engine-room were shot away at the beginning of the fight. The helm alone might enable him to keep his station. But with such communication shot away, necessitating the use of a messenger, one oblique movement might throw a squadron into disorder and compel a captain to leave the formation, temporarily at least. A system of fleet tactics must not ignore such a practical point as this. The conditions likely to obtain in action must be kept ever in mind.

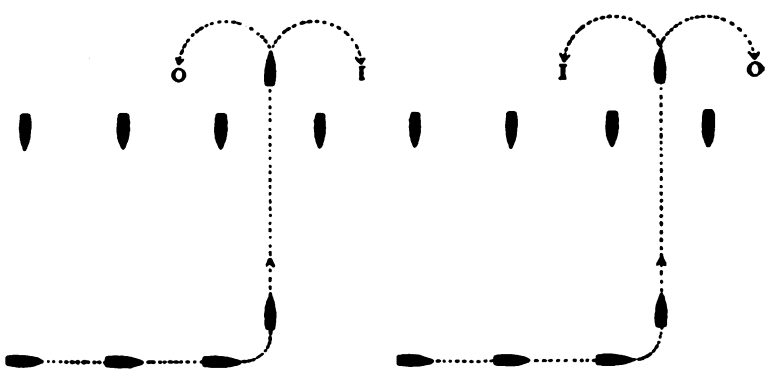
The essayist is undoubtedly right in saying that battle signals must be few and simple. It would be interesting to see how a squadron could be handled by the use of two signals, the first meaning "follow me" (in column or in circle, each ship in the wake of its leader), and the second "follow my motions" (that is, execute a simultaneous movement with the flagship). Each of these signals could be made by a single flag waved or displayed by a junior or petty officer sent aloft on board each ship to look out solely for these two important signals. Other methods could be used for the same purpose. Starting with eight ships manœuvring together, a squadron might break into two divisions of four ships, and each using these two simple signals, they could support each other as the two Japanese squadrons did at the Yalu.

I am surprised that the essayist regards the "charge through" as desirable or inevitable. It should be anticipated and provided for, to be sure, but it would seem that an admiral who has his squadron well in hand and who has confidence in its manœuvring qualities, will avoid a *mêlée* or "charge through." He might be forced to it, however, by an opponent who lacked confidence in the discipline and drill of his squadron and who would seek a condition in which chance would enter largely.

The formation in line of section columns advocated by Mr. Niblack for the "charge through" appears to be an excellent one. An extension of this principle suggests itself to me. How would it do to pass through the enemy's line in columns of divisions of four ships, as shown in the figure?

In this way the three rear ships of each division would secure a raking fire at the beginning of the movement and an effective fire while passing. After passing through, the heads of the divisions could turn *outward* O and O, and pass around the flanks of the enemy, or they could counter-

march *inward* I and I, and come back closer together with the idea of concentrating upon a part of the enemy's line, or they could turn or countermarch in the *same direction* I and O, thus maintaining the same distance between divisions. It is submitted that this plan of keeping divisions intact, if possible, might enable a squadron to come back in better order after a charge. And the adoption of this formation against the columns of sections might secure the same advantage in the " charge through " that the essayist proves for the columns of sections against the line. The distance between the divisions might permit the use of torpedoes against the enemy.



From the little knowledge I have of the subject of fleet tactics, and from limited experience afforded in our squadrons of evolution, the plan of keeping a fleet under good control by maintaining the integrity of divisions of four ships, in connection with simultaneous and rectangular movements, seems both practicable and wise.

Lieutenant SPENCER S. WOOD, U. S. N.—I fully agree with the essayist in thinking that, with our present facilities as regards types of ships and our very meagre coal allowance, we could gain much from an active discussion of tactical problems which would be of great benefit to us when we have enough ships of types which at least are somewhat similar, to prove the value of the theories advanced. True, theory in many cases has not been proved in practice, but there can be no question that an active discussion of the various theories will do much toward helping us to develop the practice, and to this end the essayist has chosen a subject from which the service should derive much benefit.

Individual intelligence is absolutely indispensable when the battle nears the duel stage, but the intelligent co-operation of each individual ship of the fleet, based on well known and established principles which have, if possible, been proved when separated from the excitement of actual warfare, will have great weight in deciding the result of an engagement.

We cannot depend much upon our signals, for at the critical time they

may fail us; we should give more time to the study of tactics and should have more actual practice.

I am not yet convinced that it would be advisable to entirely wipe out the direct method of performing an evolution from our tactics. From personal observation, when the Columbia and Minneapolis were cruising in the same squadron, I can testify to the very uncomfortable sense of nearness which was felt when these two vessels were manœuvring. Could we not modify or use the distance with a sliding scale to fit the ships which compose the fleet? Unquestionably the best results will be obtained in any practice with the best types of *similar* ships; but it seems to me that the theory of keeping "bows on" to an enemy is a good one.

It would seem, as the essayist admits, that an admiral would hesitate some time before signalling a vessel to expose her broadside to an enemy when that enemy is approaching, which would be necessary in performing the rectangular method, for by so doing he gives the greatest target possible and exposes it to the heaviest fire from the enemy, which will not interfere in any way with the enemy's advance. By training his turret but a few degrees he covers the ship which is performing the rectangular movement within the range of his heavy guns only. The rectangular movement is undoubtedly safer, and for ordinary manœuvres gives officers an opportunity of learning the capabilities of their ships, but when they have mastered these points, surely they should try the next step and drill with the direct movement, which will involve more care. To my mind the advantage carried with it more than outweighs, at times, the risk which will be incurred with extreme types of ships such as the Columbia and Minneapolis, although we are not likely to repeat the experiment of building any more of this class. It seems hardly fair to condemn the method because two extreme examples seem to interfere with the practice of it. When the tactics were written this type of vessels was overlooked, and in this special case it would seem as if these vessels might well be relegated to their original functions, viz.: commerce-destroying, and keep them out of the fighting line. They are not strong either offensively or defensively; then why harass the remainder of the line with a type which does not belong there? Let us change the distances if necessary, but let us retain the direct movement, which, with practice, could, in certain cases, be made an effective one.

It will depend on circumstances which formation will be more advantageous to use, and I frankly admit that the essayist's reasons for using the rectangular as much as possible are excellent. I simply plead that both should be retained in the tactics and practiced. I will also admit that I have tried to imagine formations where the direct method would be so much better than the rectangular that it would justify the additional care which would be necessary to perform it, but I have been unable to think of more than a very few cases.

I fully agree with the essayist in thinking that the more we can reduce the need of signals in action, as well as insure certainty of being able to use some simple method, the more ready will we be to go into an action.

It would be interesting to see experiments with some method of day fireworks. The Japanese are clever in showing floating shapes of horses, boats, etc., in the air, and we might make use of paper shapes which would float in the air to indicate numbers or even well-known manœuvres.

The smoke may interfere at times, but these would be more likely to be visible than any system of flags or shapes which we could hoist on board ship, and in closer quarters the whistle would be used.

There is no question in my mind that an admiral or captain would be unable to remain cooped up in the present conning-tower during an action. He would require a position from which he could see more, and if we cannot improve the present tower, might we not materially increase his power of observation by having a second tower aft? There a subordinate would be stationed who should be in direct communication with the other tower. Both towers should be fitted with the same instruments, and perhaps it might be well to have the captain of the ship and the navigator in the after tower and the admiral and his chief-of-staff in the forward one. It is surely better to separate those who will succeed to the command in case of accident to the commanding officer.

Another point which the essayist has touched on lightly, but which would seem to merit a little more attention, is the following: "We do not know the tactical qualities of many of the newer ships, and it is not good policy to publish the tactical data of those now in commission." Knowledge of the tactical data of an enemy's ships would be of great advantage in or before an action. Let us then cherish the little we have found out about our ships and throw at least this obstacle in the way of an enemy knowing as much as we do. We invite foreign officers, naval and military attachés, to our gun tests; armor and steel contractors are so anxious to advertise their products that they give all possible information in regard to them, and the contractors for our ships are equally ready to furnish foreigners with information to show the handiness of the vessels they have built. Are we not a little too willing to give foreigners all the data they request?

The essayist's diagrams of gun-fire and effectiveness of ships give an excellent idea of the powers of the various types of ships.

As regards the manœuvre of "charging through" an enemy's line, which is claimed to be the great desideratum to be striven for, I do not entirely agree. That such a movement may be advantageous at times is evident, but it would seem that the second or third line of weaker ships would be in a most embarrassing position should the enemy turn short under their sterns and form column, provided, of course, that the lighter vessels could survive an action at such close quarters as they would be exposed to in passing between two of an enemy's ships. Another point which seems worthy of consideration: would not the fire of our own adjacent ships be likely to prove decidedly uncomfortable, if not actually dangerous, to our friends? We aim to hit our enemy, of course, but even at such close quarters an error of a few degrees would carry a projectile clear of an enemy's top works and land it in a friend's side. If, however, this method is employed and we decide to carry torpedoes on

our ships, would not this be our time to use them from the forward broadside tubes? There is a risk of their being struck before they leave their tubes, but the risk is really no greater than at any other time when they are carried in action. There will only be a short time that the tubes will be a target for an enemy's guns, whereas in column they are exposed fully from 45 degrees forward to 45 degrees abaft the beam. In this formation only the 45 degrees forward will be the dangerous zone when an enemy approaches from the bow. It would seem as if the torpedo would prove less dangerous to our friends in the "charge through" than the gun-fire. With fleets of about equal power, the charge through might be advisable; with the superior fleet it would be likely to prove most advantageous; but with a slightly inferior fleet the manœuvring to cut off part of the other fleet would be the wiser course to pursue.

In closing I should like to join my voice with that of the essayist and second most heartily what he says in his closing paragraph in regard to the utility of the Naval War College.

Lieut.-Comdr. Richard Wainwright, U. S. N.—Lieutenant Niblack's essay is a most valuable contribution to the art of naval tactics, and will be read with interest by all students of that branch of the profession of a naval officer. In the following sentence he sounds the keynote of fleet tactics: "The object of all manœuvres in a fleet action is to get and keep the enemy within effective range; to blank some of his gun-fire by getting a superior position; to hold an advantage gained, or, losing it, to manœuvre for a fresh one." Holding this in mind as the introduction to 31 tactical propositions, one is naturally surprised by the 24th, which is as follows: "Under average conditions, the best initial formation for the approach to the attack is *line in some form or other*. If the enemy is not in line also, and a charge through is not practicable, column will probably be used until a charge through, line to line, can be forced on the enemy." This is more fully explained under the heading "The Fleet in Action on the Open Sea"; on page 21 is the following sentence: "3d. *The attack*.—It will be a surprise to many to meet with the statement that a charge through, line to line, with the enemy, should be eagerly sought for and tactically striven for. If, in the approach, the enemy is not in line there is no use remaining long in line, for if he is in any other formation, column is the best form of attack under most conditions. To remain in line, the enemy being in any other formation, is to invite a concentrated attack on either flank." In other words, the best initial formation for the approach to the attack is line, and charge through with both fleets in that formation should be eagerly sought for. Does this agree with "the object of all fleet manœuvres," as stated in the opening sentence? Is there any attempt to get a superior position, to blank some of the enemy's gun-fire or to gain an advantage? Both fleets being equal in all points, the charge through leaves the advantage to be gained to the chances of a lucky shot. Most of the propositions and conclusions of the essayist are sound, so that this conclusion causes the greater surprise, for it is radi-

cally opposed to all the other statements in the essay. Lieut. Niblack's scheme for approaching in indented line and going into column of sections for the charge through would be an excellent one should the enemy remain in single line, and I imagine this scheme has led him to advocate the charge through.

His treatment of the questions of gun-fire, speed and turning power is logically sound. In the question of formation he states of echelon, "As a continuous battle formation it has ceased to have many advocates." This is true of all formations. A tactician may well have a favorite formation for approaching an enemy, but his formation must be changed to meet the varying circumstances due to the formations and positions of the enemy.

Lieutenant R. C. SMITH, U. S. N.—While I agree entirely with much of Lieutenant Niblack's essay, I do not believe it can be assumed as certain that torpedoes will not be used in the "charge through." The prohibitive consideration, as stated in the essay, is that they will be dangerous alike to friend and foe.

Now, whatever danger there may be to friends must arise from one or more of the three following suppositions:

1. There will be friends as well as foes on bearings commanded by torpedo-tubes, as the fleets are passing.

2. Torpedoes are erratic, and may hit a friend on a widely different bearing from that of the enemy aimed at.

3. Torpedoes that miss may remain afloat after their run and prove a source of danger to friends in the second or third line.

Considering these objections in order:

1. In the formation suggested in the essay the rear ship of each section would have a fine chance to use its broadside tubes as soon as the enemy's leading ships bore. For with tubes trained abeam, or abaft the beam, and a deflection of the torpedo due to the speed of the ship, no friends of the same line could possibly be reached. If the torpedo missed its aim and ran far enough, it might reach a friend in the following line. Our torpedoes are adjusted for one speed and one range; the latter 800 yards, the former the highest attainable, and at least double any speed that would be used in a fleet action. Assume that this 800 yards brought the torpedo in the course of a friendly section in the next succeeding line. While the torpedo was running 800 yards, or four cables, the following line would not have advanced more than two cables. As there are six cables between lines, four cables, or 800 yards (less a ship's length), would represent the clear space this torpedo might bring up in without danger to a friend. The rear line would not be subject even to this limitation, but could launch its torpedoes with impunity as soon as the enemy passed abeam.

But if we consider the enemy's formation as supposed in the essay, namely, some form of simple or double line, it is seen that he is at an advantage as regards torpedo fire, and could hardly fail to make hits with his quarter tubes firing obliquely through our double or treble indented line.

In the above, the formation is considered regular. In case of irregularity there would be times when friends and foes might be bunched as the tubes bore; but this in itself would involve possibilities of open spaces with enemies alone in other parts of the field.

It is also worth noticing that whatever objections obtain against torpedoes that fail to hit in these circumstances apply equally to gun fire. There would be of course a large proportion of hits at such close range; but to offset this, the projectiles that missed would by their greater range be more apt to strike a friend than a torpedo that missed. The essay, however, assumes that the captain will control the gun fire when friends are in danger. As will be seen later, the officers at the sighting stations can likewise control the torpedo fire.

2. It is hard to reply to this objection without writing an article in itself. At the risk of occupying too much space, I will try and mention briefly the main points. In the first place, what torpedoes are considered, and what is the location of the tubes? In our own service we have at present the 14-inch Howell and the short 18-inch Whitehead. The latter is admittedly very hard to get into the water on a predetermined course, though its path is straight enough after it gets started. In Europe almost all nations are adopting the long 5-meter type, which is appreciably more accurate; and we ourselves shall also have them shortly, as the specifications are now in course of preparation.

In regard to the Howell, whatever its other faults, no one can claim that it is not accurate laterally. When launched from the broadside of the Stiletto at 15 knots its deflection is only one-third that of the Whitehead from the Cushing at the same speed; and, what is more to the point, its deflection is exceedingly uniform. In the larger 18-inch type, for which the specifications are now ready, even better results are to be anticipated.

Then, too, the location of tubes is to be considered. There has been an entire revolution of opinion since the days of the English Scout, 10 or 11 years ago. All cruisers then and subsequently were torpedo cruisers, whatever their speed, and their tubes were mainly over-water. Opinion now tends decidedly to omitting torpedo-tubes from all vessels except armor-clads and torpedo-boats. The reason for removing them from cruisers is not that there is material danger of an exploding warhead, which has been shown by careful experiment to be remote; nor even that the air-flask may be burst, a much more probable occurrence; but simply that the launching gear would be shot to pieces before it could be used. This reduces the case to submerged tubes in battle-ships and large cruisers, or over-water tubes behind armor. Torpedo-boats are not here considered.

Now as to the accuracy of fire from submerged tubes, it is a question of providing an apparatus strong enough to withstand the great force of the current of water past the ship. This done, the practice should be far more accurate than from over-water tubes, for this reason. There is one sole deflecting force, the current of water past the ship, which is uniform for uniform speed. From an over-water tube the deflection is

dependent not only on the speed, but on the angle of entry, which varies with the roll of the ship, the roughness of the water, and accidental variations of the impulse. The development of a strong and reliable apparatus has been extremely slow. The English so far are apparently the only nation who have made a satisfactory solution; and that their solution is satisfactory the following random quotations will indicate:

1892. An English officer, an acknowledged torpedo expert, whose name I am not at liberty to mention, considered that practice from broadside submerged tubes up to a speed of 14 knots was as accurate as was possible with the Whitehead torpedo under any circumstances.

1892. The Royal Sovereign at torpedo practice at 600 yards at 11 to 12 knots: "The practice was not very good from the over-water tubes, but fairly good from the submerged tubes."—Annual of Office of Naval Intelligence, 1894, page 126.

1893. The Sanspareil at a speed of 12 knots was reported to have launched 14 torpedoes at a moving target (speed not given) 40 yards long and 700 yards distant. 5 of the 14 struck the target.

1893. The Vulcan at a speed of 18 knots made 11 hits out of 16 against a fixed target 100 yards long and 600 yards distant.

1894. Commander Sturdee, R. N., in the Prize Essay of the R. U. S. Institution, page 375: "From above-water tubes 450 yards may be considered as the effective torpedo range between ships under way, while an extra hundred yards may be allowed from submerged fire. Within that range about 50 per cent of hits ought to be scored, a larger percentage having been actually made in the different annual manœuvres."

It may be added that if the English have succeeded, other nations will do so in time. Broadside tubes only have been considered, as bow and stern tubes, over and under water, are everywhere disappearing. The forward pairs of broadside tubes are usually fixed abeam, and the after pairs at an angle of 20 to 30 degrees abaft the beam. They do not admit of train.

3. This danger may be absolutely obviated by removing the drain plugs from the buoyancy chamber when the war-head is attached. This is the rule in our service. The accuracy of the run is in no way affected, as has been abundantly proved by experiment, and the torpedo must necessarily sink shortly after it ceases to run. A sinking lever, which automatically opened a valve, was formerly used for this purpose; but as it sometimes did not act, its effectiveness was discredited.

A word as to the control of torpedo fire aboard ship: I believe I am right in saying that the policy recommended in our service, and the theory on which our sighting arrangements are installed, is that the captain controls the bow torpedo exclusively, when there is one (the desirability of its presence is questioned), and gives general directions to the officers at the remaining sighting stations, "enemy on such a bearing," it being understood that the officer fires if he gets a chance. This is also the practice in foreign services. The captain cannot give his attention more in detail than this. But with this arrangement, and a "stand-by" from the captain, if the officer at the sighting station sees

a good chance to torpedo a passing enemy without danger to friends, as I believe he will in any form of "charge through," the torpedo is launched at once without further reference to the captain, except to notify him that the torpedo has been fired and to inform him when another is ready.

There is one consideration that somewhat impairs the above line of argument, and that is the effect of smoke in shutting out all except near neighbors. But this militates no more against the torpedo than the gun; and with the adoption of smokeless powder the inconvenience will be reduced to a minimum.

The essayist makes no mention of large torpedo-boats, or torpedo-boat destroyers, in the enemy's line. His own boats he places with the reserve. But it is quite commonly held abroad that these craft should accompany the battle-ships in the line, keeping under their lee in action. They would want no better chance than to have us charge through their line. But I doubt if Lieutenant Niblack would advocate the "charge through" in this case, even if we had an equal number of destroyers.

At least one other writer recently has held opinions somewhat similar to those advanced in the essay, in that he regards the "charge through" as desirable under certain circumstances; but he does not urge it as the "great desideratum." Lieutenant Calthorpe, R. N., in the R. U. S. Institution in May, 1894, in an essay that received special mention, writes as follows, page 488: "It is conceivable that it would be good tactics to endeavor to pass through the enemy's fleet 'en masse,' that is, in concentrated formation, invariably manœuvring to meet them 'end on'; and then to turn, reforming on guides immediately, with the object of falling upon them, if possible, in a weak spot, according to circumstances, before they have themselves had time to turn . . . and the side which succeeds in concentrating a majority upon some defective spot in the opponent's fleet will have gained a great advantage."

Generally speaking, he advocates other tactics, and quotes Captain Mahan as follows, page 496 of the Proceedings: "He believes that a fleet seeking a decisive result must close with its enemy, but not until some advantage has been obtained for the collision, which will usually be gained by manœuvring, and will fall to the best drilled and managed fleet."

His own conclusion follows on the same page: "This, then, would appear to be a very sound tactical principle. Try to out-manœuvre the enemy and fight him with your guns, remaining outside the range of his rams and torpedoes until you have obtained an advantage, and then fall upon him, in his weakest spot if possible."

He also has this to say on the subject of torpedoes, page 489: "A few officers there may be who are still of opinion that torpedoes should not be 'let loose' in a fleet action at all, on the grounds that they will be as dangerous to friends as to foes. Doubtless they might be if discharged indiscriminately, but in many cases (on first going into action, for instance, in a formation of narrow front) each ship might get beam shots on passing the enemy with, practically speaking, absolute safety to her consorts." As has been shown, there might also be chances in a line formation. Con-

tinuing the quotation: "Here, then, is the opportunity for submerged tubes. The dangerous objections (referring to over-water fire) already discussed disappear altogether; and this weapon, the submerged tube, I hold to be one, if not *the* most important engine of destruction in a ship. A vessel may be crippled, her steering gear shot away, her machinery disabled, half her guns dismounted or out of action, and, in fact, be in a semi-sinking condition, and yet retain intact on each broadside a weapon representing the destructive force due to about 200 lbs. of gun-cotton. The torpedo practice in our navy from submerged tubes has, on the whole, been very good at everything but extreme speeds, and fairly straight shooting might be anticipated with confidence at speeds up to at least 15 knots, which speed will probably not be exceeded by large fleets manœuvring in close order." Also on page 509, one of ten conclusions as regards fleets: "8. That torpedoes should be freely made use of from the beams of ships, when passing the enemy at close quarters."

Commander Sturdee's opinion as to the method of going into action, in the essay previously quoted, page 396, is as follows: "I lean very strongly to the opinion that the gun is the most important one (weapon) at first, because, as in the case of a single-ship action, on account of its long range; but even more so of the danger of coming within torpedo and ramming distance without having first obtained an advantage over the enemy, and I would lay it down as an axiom that no fleet should risk a close encounter (at first) without having obtained a tactical advantage over the other one, as otherwise it becomes a matter of chance what will happen on a charge being made, supposing both fleets are equal and in similar formation." He also cites Captain Mahan in the quotation already given.

After a careful reading of the essay, the advantages claimed for the "charge through" seems to be that, if the enemy is in some form of simple or double line, and the attacking force is in two or three indented lines or lines of sections, then the attack will by its formation possess a better command of fire, some of the supporting ships of the second or third lines may find a chance to ram ships of the enemy disabled in passing through, and the squadron which reforms quickest after charging will possess an overwhelming advantage.

Now comparing the two formations as described above, and supposing the fleets of equal strength, it will be seen that one is essentially a broad front formation with slight depth, and in the other the front and depth approach equality.

Then suppose the enemy to be a believer in this principle, page 21 of the essay: "To remain in line, the enemy being in any other formation, is to invite a concentrated attack on either flank." The line would evidently soon be abandoned. It will not do to say that you are not in another formation, for if you have three lines your formation resembles column of divisions; and it is in any case a narrow front formation as compared with the enemy's.

If the enemy remains in line until a charge seems imminent, he still has

one or two counter-moves. His flanks overlap at both ends of the line if the demonstration is against the center. He may form indented columns on the center of wings and allow you to pass through, unless you still have time to countermarch. All his inner broadside guns and tubes will bear, and only those of your flank ships.

Or he may leave his center to receive the charge, countermarch with his flanks, form column or echelon in the rear, and envelop you on either hand, trusting to his center to reform and bring up the rear. You would hardly attempt to reform under these circumstances.

But it is not very satisfactory to follow through a series of counter-moves, except in the war games, for the simple reason that you cannot assume your adversary's answer.

Therefore suppose the charge to be made as intended. It has already been shown that the enemy having no rear lines to hamper him will be free to use his beam and quarter torpedo-tubes as soon as they bear, without in any way endangering his own line, and with every chance of successful runs on diagonal courses across your compact formation.

Then, too, the enemy with his simple line can reform in about a quarter of the time it will require for the deep formation by either method described in the essay, and will hence secure the "overwhelming advantage."

Finally, the question of the "charge through" reduces itself to the supposition that the attacking fleet is possessed of greater skill, first in the adoption of its tactical formation, and second in reforming after the charge. Now, as in "charging through" I believe it to be clear that the attacking fleet subjects itself to the possibility of both torpedoes and accidental ramming, it would be by all odds the part of policy to use its superior skill in selecting tactical formations that would permit of concentrated gun fire on portions of the enemy until he was whipped in detail, to avoid the enemy's rams and torpedoes if possible, and not to seek to use the ram or torpedo except when forced to do so in defense, or in the final onset after some considerable advantage had been already assured.

In conclusion, I will say that I agree with Lieutenant Niblack in the other features of his essay, and congratulate him on his success. I shall not venture to hope that my arguments as above cannot be controverted, but I offer them as giving another view of a very important matter.

Rear-Admiral S. B. Luce, U. S. N.—I have read this essay with pleasure and profit. The writer approaches the main question in the true spirit, laying down general principles and reasoning from them in a logical manner. This is the only proper method of reaching just conclusions.

One of the causes, I may say the chief cause, of the variety of opinion as to the best battle formation for a fleet lies in the ship which is to take its place in the line of battle, commonly called the line-of-battle ship. The battle formation is determined by the tactics of its units, and the tactics of the units are determined by their chief characteristics. Variety of characteristics requires variety of treatment.

In the galley period, when the ram was the principal weapon of offense, the battle formation had to be in line, or modifications of the line, the prow pointing towards the enemy. It could not possibly be otherwise. The crescent formation of the Persian fleet at Artemisium, the formation at Arginusæ, the indented line of the Roman fleet commanded by Cæsar off Alexandria, the double echelon of the Romans in the battle of Ecnomus, are familiar examples of this. On the first introduction of guns on board ship, the galley, or, more correctly speaking, the *Galleas*, had end-on fire, as at Lepanto. The gun and the ram acting in unison necessitated a continuance of the line as the normal formation for battle—the line, that is to say, with its modifications of echelon, single and double, or with its flanks thrown forward, as in the crescent formation. During the sail period the tactics of the ship was equally imperative in requiring the principal battle formation to be in column, in order to present to the enemy the principal weapon of offense, the gun, which was placed in the broadside. The ships themselves were in column, while the guns were in line. No other battle formation was possible.

Some of the earlier writers on steam tactics, finding the gun still in broadside and the ram restored to its ancient functions, were compelled to give the battle formations of both the periods represented. Hence they laid down the rule: "The line (single or indented) for ironclads and rams; the column (single or indented) for ships whose offensive powers lie in their broadside batteries." The effort to adopt one standard battle formation for both classes of vessels, without due regard to the principal weapons of offense, naturally led to some confusion. It was an attempt to formulate a system of fleet tactics without considering the tactics of the units. The resultant confusion was somewhat intensified by practice when fleets composed of various classes, or rather of various types of ships, have undertaken to perform military movements. In the battle of Lissa, both the Austrian and the Italian fleet were composed of the latest type of ironclad of that day, and wooden sailing-ships having auxiliary steam power. With the heterogeneous assemblage of ships, Tegetthoff bore down on the Italian fleet (the latter in column of ships) in column of squadrons, each squadron formed in double echelon. The Kaiser, an old 90-gun ship, with head booms and the old style of cutwater, undertook to ram the Italian ironclad Rè di Portogallo and was fortunate in being able to reach an anchorage in San Giorgio. I have referred to this incident in the January number of the *North American Review*. At the battle of the Yalu the Chinese fleet came out to give battle in an irregular line, while the Japanese moved up to the attack in column. Referring to this battle, Admiral Colomb, of the English Navy, says it was a trial of strength between two tactical formations—the line and the column. "I ventured to declare in former tactical studies," he says, "that the line-abreast was an exceedingly weak formation which ought to succumb to the line-ahead in all cases where things are otherwise equal." (Essay on Naval Defense, 2d Edition, by Vice-Admiral P. H. Colomb, R. N.)

In his very clever and entertaining skit describing, in the "Battle of

Dorking" style, a battle between an English and a French fleet, Captain Eardley-Wilmot of the English Navy forms the English fleet in double echelon, "the flagship leading, the other vessels ranged on her quarters, making an isosceles triangle. Thus the squadron had the shape of a wedge, in which each ship's ram and bow fire were clear of the next ahead." This was the formation of the Roman fleet under Marcus Atilius Regulus, minus the *triarii*. [An account of the principal battle formations of the galley period will be found in Proceedings of the U. S. Naval Institute, Vol. III., No. 1, April 20th, 1876.] The French fleet were "in two divisions, line ahead,* a formation that meets with the unqualified approval of the metaphorical Paul Brachet," and, by implication, that of the ingenious author.

I have traced these successive steps in the history of naval tactics with a view to calling attention to, and emphasizing the fact that the essayist has touched the root of the matter when, to the question, page 20, "In what formation should we approach to the attack?" he answers: "that in which the maximum number of heavy guns can be brought to bear at long range." This sound principle had already been enunciated on page 17, where it is stated, as the summing up of the 31 tactical propositions, that "the most practical method of arriving at sound conclusions is to analyze the gun fire and the tactical qualities of the ships we have, and deduce tactics to fit them."

As the line of battle, which forms the basis of every system of tactics, must be made up of ships of sufficiently high military value, I cannot help wishing the author had been a little more explicit in the statement first quoted, and had recommended, as no doubt he intended to do, the deducing of a system of tactics best adapted to the gun fire and tactical qualities *of our line-of-battle ships*. A system of tactics based on the offensive and manœuvring powers of a ship of the line of the Massachusetts type might not be suitable for a light cruiser of the Montgomery class. The rôle of each class is essentially different. It will be the duty of the tactician to classify our ships and indicate those that are to be admitted to the line of battle and those that are to perform functions in connection with the line of battle, and from those elements to deduce his system.

In the passages first quoted lies the gist of the whole question. It was that very principle, as laid down by the author, that determined, as we have seen, the battle formation in the oar and in the sail period. Reasoning from that fundamental principle, the true solution of the problem cannot be very far off. The English Naval Prize Essayist of 1879 said of naval tactics, "We are groping in the dark," a fact we may reaffirm with the qualification, thanks to the author and those working on the same lines, that dawn is breaking.

I find myself compelled to dissent somewhat from the author on one point. He recommends, on page 27, that a complete scheme of tactics "should be worked out by one or more drill squadrons, or a *fleet of steam launches*. . . ." If we can keep up one squadron of evolutions we

* *New York Herald*, Sunday, Jan'y 26th, 1896. Fifth Section.

will do well, but the flotilla of launches is a poor substitute for it. The views on this subject of the distinguished French Admiral Jurien de la Gravière may well be quoted on this point. It was proposed some years ago in France to reduce naval expenditure to such an extent that the Minister of Marine would be no longer able to keep up the Mediterranean squadron of evolutions. "That squadron," the admiral observes, in opposing its abolition, "is the school where the young officers apply the knowledge acquired in all others." "It is the source," he continues, "whence our officers and crews derive their true naval spirit. For this reason alone the squadron of evolutions should be maintained at any cost. But a more important consideration yet urges its continuance. *It is our only school of tactics.* The fleet most thoroughly drilled in naval tactics will have the greatest advantage in war."

"When opposing fleets join battle the lines will be broken through, and immediately every ship will have to reverse her course to resume the fight. This manœuvre must almost inevitably result in collisions among ships of the same fleet. If these ships are all homogeneous, and describe equal arcs of evolution, the risks of collisions will be small; and if to this there be added a constant habit of manœuvring together, those risks will disappear altogether. It is not simply in practising regular evolutions and following geometrical lines that gives the self-possession so essential in battle. Neither single cruisers nor the semblance of a squadron composed of steam launches or gunboats constitute an adequate school for this difficult art."

"It is absolutely necessary to accustom oneself to handling, within contracted spaces, masses of from eight to ten thousand tons, which cannot collide without mutual destruction. One must become accustomed to the imminence of such dangers; to become habituated to the close order of steaming by night as well as by day, in fair weather and in foul; to know how to form groups; to extend the lines, to mass the ships or to throw them out in echelon. Above all, one must be possessed of the faculty of placing himself in full sympathy with the commander-in-chief, to have an intuitive perception of his designs, and to anticipate his movements without the use of signals. Herein lies the whole secret of naval tactics. There is but one definition for this species of tactics: it is the art of manœuvring in battle, and while rendering support to your consorts, to avoid fouling them. The most skillful are those who can execute fleet evolutions when the transmission of orders has become impossible. The very last measure of economy France should resort to, then, is, in my judgment, the dispensing with the squadron of evolutions."

Did these views need confirmation it would be found in the work accomplished by the French squadron of evolutions. It has produced two of the best works on naval tactics. The *Tactique Navale* and *Tactique Supplémentaire à l'usage d'une Flotte Cuirassée*, par Vice-Amiral Cte. Bouët-Willaumez, was the direct result of that officer's term of service as its commander-in-chief; and this was followed by *Escadre d'Evolutions, 1868-1870, Considérations Generales sur la Tactique Navale*, par Vice-Amiral Jurien de la Gravière.

In the course of a few introductory remarks in the later work occurs the following: "Chargés par le Ministre d'entreprendre la révision du livre des signaux et de la tactique officielle, nous n'avons pas perdu de vue les conditions dans lesquelles cette révision allait s'accomplir," etc.

It will be seen from this passage that the French Government took sufficient interest in such matters to direct the commander-in-chief to utilize his squadron as a School of Application and to do exactly the work proposed by the essayist. That is one picture, and here is another. It is within the memory of men still living that attempts to utilize an American squadron for similar purposes were repeatedly and determinedly frustrated by the American Government; and when, with the remains of a depleted squadron, a final effort was made in that direction it was seriously proposed to make the officers concerned pay for the coal expended! Is it to be wondered at, then, that the author should tell us "our books on tactics are primers, our signal books a monument to those who do not go to sea"?

The essayist has very properly devoted one chapter to definitions. Naval tactics is entitled to a terminology of its own. But I think the author is slightly in error when he says, page 9, §6, that our books on tactics are based on foreign works. He then tells us that *column* is here taken to mean "line ahead," etc., etc.

Commodore Foxhall A. Parker, U. S. N., prepared his *Fleet Tactics under Steam* in 1869. It was published by authority of the Navy Department. Six years previously he had been drilling seamen with a field battery of naval howitzers, and conceived the idea of adapting the movements of an assemblage of fieldpieces to the flotilla he subsequently commanded. In the preparation of his work he was no doubt indebted to the treatise of Vice-Admiral Bouët-Willaumez. However that may be, Commodore Parker discarded the terms that had been used in the old naval tactics under sail and stated that there "are but three formations for a fleet . . . any one of which may constitute an order of battle, viz., line, column, echelon."

Captain Hoff, in his last work on tactics, adopted the same terms. It seems hardly necessary, therefore, to use "foreign terms to express formations," or even "to state their equivalents." Captain Hoff also uses the term *line-of-battle ship*, a name by which our first-rates should be designated. Under the head of Tactical Propositions, page 10, the expression "steam fleet battle tactics" is unnecessarily cumulative. The word "blank," in "to blank some of the enemy's gun fire," sounds (or reads) like the euphemistic form of the not wholly unfamiliar damn. Thus in one account of the battle of Mobile we read that Farragut cried out: "*Blank the torpedoes! Go ahead!*" The verb "to blank" is used here, presumably, in the sense of *to mask*. The latter word has the sanction of good military usage. But these are very small matters. The essay is an able one, and a welcome indication of the progressive spirit of the Navy.

Lieutenant A. A. ACKERMAN, U. S. N.—Lieutenant Niblack is to be congratulated upon having so clearly and briefly brought the fundamental principles of a modern naval tactics into one's mental grasp. The essay is all the more admirable that in spite of its brevity it is so full of suggestion. No one can read it without beholding in every direction vistas of possibilities and being impelled to investigate for himself this old subject revived through changed conditions to a new and fascinating youth.

While thus recognizing the great value of the essay, there are certain considerations to which I ascribe a different weight than the author, and accordingly carry my conclusions not so far or farther than he does. Possibly my lack of experience in fleet manœuvres, or their systematic study as pursued at the Naval War College, has permitted me to err, in which case a speedy correction is most desirable.

Modern naval tactics seems to be a tactics of gun fire alone. When it is considered what great sacrifices are made in order to clothe battle-ships in armor, or to give them a knot more speed, it is natural to desire to get some return; yet battle-ships, when in fleet formation, are to be handled almost as gingerly as cruisers, and their extra speed, if they have any, is thrown away.

Now it would seem that that admiral whose tactics required the armor to do its share in the fight as well as the guns, and which made the knot more speed compensate in some way for the consequent lighter battery, would be more worthy of success than the one who treated his ships like so many units.

The fact is, the effect of gun fire under battle conditions is as much overrated as the defensive power of armor is underrated. The battle-ships are built to stand punishment, and if any of them are disabled by gun fire alone, it will be because of a lack of armor rather than in spite of it.

Thus far the characteristics of individual ships seem to have been assigned neither credit nor debit values in naval tactics. In fact, two of the most important of all, namely, ammunition supply and marksmanship, have not been mentioned at all; yet both of these are deeply involved, and merit early consideration in the design of the ship.

One agrees with Lieutenant Niblack that we must deduce tactics to fit the ships we have. But then our ships should be designed to fit the grand tactics best adapted to the exigencies of the national defense; so that actually the best minor tactics are derived ultimately from the best grand tactics. Thus grand tactics will fix the size of the fleet, its disposition, and the duties and responsibilities of its various subdivisions. And the duties of the individuals should determine their draught, coal supply, speed, offensive and defensive powers, and finally, the minor tactics.

For example, it is possible for a nimble opponent with numerous ships to establish a flexible blockade, which would recede without breaking before a sortie of coast-defense vessels, only to flow back when the pressure was relieved. And this might continue indefinitely before one or more ports, until there was concentrated an overwhelming fleet

capable of crushing the defenders of each port in succession. This seems to indicate the advisability of adding to our purely defensive fleet of battle-ships a number of powerful armored cruisers carrying 10 or 12-inch guns. In these vessels the offensive should predominate. It is asked, however, that the supply of ammunition to their guns should at least be no more precarious than the service of the guns themselves. They should have speed and a great radius of action; in fact, they should be the stormy petrels of the Navy; and living and fighting at sea, the question of draught should not be permitted to impair their efficiency.

With regard, however, to the defending fleet. Our coast and harbor-defense vessels cannot choose their opponents. They must take issue with any and all who come. Reliability and endurance are, therefore, qualities which in these vessels should overshadow all others. At the same time their offensive powers must be great, or they will fail in their purpose of intimidating or destroying the enemy, while perhaps not suffering destruction themselves. It must be admitted that when the individual organizations lack the quality of endurance, to say nothing of *permanence*, the most brilliantly conceived evolution may result in confusion, if not demoralization. Failure to consider this fact must condemn any tactics. Yet theorists regard a ship as more or less formidable, if we take the diagrams, according to the energies of its gun fires and the arcs over which these energies may be delivered. Nothing is said of the vulnerability of the ship, and yet upon that more than the dependent gun fire, speed, or any other quality, rests its ability to carry out its part of the evolution and maintain the fight. It seems no more than common-sense and good military practice to take full account of the effect of more than probable disasters. It is the weak points in a ship's design, and its interior organization as affected and dependent upon that design, which will determine its value and reliability in war, quite as much, if not more than, the arcs and energies of its gun fire.

The less vulnerable the battle-ships are, the more independent they will be; the greater the power to extend a line of battle without rendering it fatally weak, or to undertake isolated movements without fear of being destroyed in detail. With an extended formation every gun may be brought to bear, while concentration is certain to mask some of them.

The time interval mentioned by Lieut. Niblack is most important as affecting concentration of fire when the fleets are moving past each other. If, for example, it is intended to concentrate the fire upon a certain squadron or division of the enemy, and the opportunity or necessity for a "charge through" presents itself, the formation of columns of sections in three lines as proposed by Lieut. Niblack is undoubtedly most powerful. I prefer, however, on account of the time interval, to go farther and close up the lines for the charge, forming from each column of sections an indented column. For the enemy has a time interval as well as ourselves, so that if we can place a new Hartford at the head of the column to take the first shock without faltering, the advantage of the continuous concentrated fire delivered by each suc-

ceeding ship as it approaches and passes through the enemy's line is evident. In fact the two ships between which each column passes would have received six successive broadsides at close range while delivering only one, or perhaps two, at widely separated ships. If the charge had been made in lines, each line would have received its broadside.

In all evolutions of this character the time interval and the relation which it bears to the range of effective gun fire—and that varies with marksmen, weather, guns, and defensive powers—is most important. Full credit should also be given to the natural defensive advantages possessed by every armored ship in a naval engagement. The gun rarely, if ever, can obtain favorable simultaneous conditions of normal impact, short range, and precision of fire. For that reason armored ships should be required to manœuvre boldly, making as full use of their defensive as of their offensive powers. The advisability of such action, however, does not seem to be brought out clearly in any tactics. When the effort is not made to obtain all the advantage possible from the enemy's time interval by bringing a column of as many vessels *successively* past the point of attack in that time as possible, the "charge through" partakes more of the desperate effort of a losing side.

It is true that in the "charge through" in lines six cables apart, certain of the enemy's ships will be exposed successively to the fire of several of our ships, and therefore, supposing all the ships equal in other respects, they will have borne all the casualties, which in our own case is distributed over a larger number of vessels. Nevertheless, this plan seems to me advantageous only as an *offensive-defensive* method of fighting. For the fire of the weaker second and third lines is masked by the first line, which takes the brunt of the attack. In other words, offensive power is sacrificed to an extent in order to obtain a lesser advantage with less risk. It is therefore the method of fighting which would suggest itself to that admiral whose guns are less powerful but more quickly served than his opponent's, whose vessels are light and speedy rather than weighted down with armor; it is in fact the manœuvre of cruisers rather than of battle-ships. With battle-ships having a slow fire the defensive arrangements become all the more important; still the masking of their guns through formation in masses causes a most serious loss of offensive power. If, for example, a 13-inch gun cannot be counted upon to deliver more than ten shots an hour, it is evident that they should be in action continuously in order to obtain effects at all commensurate with their energies, otherwise fragile cruisers and lesser guns will have played their part and perhaps have passed away before the real power of the fleet is felt. Delayed action is always sought by those seeking to avoid or fearing a general engagement. If the defensive power of our battle-ships is sufficient and as great as it should be, the best effect as to concentration of our own fire and the scattering or weakening of the enemy's would be obtained by deploying our own vessels around those of the enemy when massed.

Apart from the loss of offensive power, there seem many dangers connected with the "charge through" in lines. Take, for example, our

fleet in three lines of six or more vessels, each about to make a "charge through" the enemy's left division of six ships. It is evident that with so many vessels to arrange with due regard to their speed and powers of offense and defense, this opportunity must have presented itself, rather than have been intentionally brought about; unless of course our vessels are far more speedy than those of the enemy, or the latter has adopted a purely passive defense. However little time the preparation for this movement has taken, it is hardly possible that it could have escaped comprehension by the enemy. It seems also that the order for the charge past must have been given at some point outside of battle range; also that once the charge is commenced, inextricable confusion is apt to result from an unexpected change of plan when under fire. If there is time, however, for the enemy to make a single signal, what was a decided advantage to us may become a disaster. All that would be necessary for him to do would be to retract his left flank by forming the division *to the rear* into column, right vessel leading. This movement should be direct and at reserve speed, for time is precious and each ship must for the moment look out for itself. During the manœuvre the broadsides of six vessels are brought to bear on the three heads of the charging columns of sections. When the division has formed column, the charging lines, after having received the port bow fire of the enemy's entire fleet, must pass in succession the six ships of the column, receiving a broadside from each, while each line, on account of the masking of guns and the time interval, is capable of delivering in return a broadside from but two ships. If we suppose the enemy's fleet to be also composed of three divisions of six ships each, it is probable he would find a way of continuing and improving his advantage. It is evident that a minute or two lost in such a manœuvre may turn possible victory into defeat; so that Lieutenant Niblack's recommendations as to the simplicity and small number of battle signals, as well as the necessity of a great variety of methods of publishing them, is of vital importance.

Possibly our admiral would endeavor to avert disaster by forming his lines into échelons, the right leading, so as to bring all of his guns to bear, and he might charge with that signal flying, otherwise confusion seems inevitable.

The advantage seems to rest with that fleet which last adopts a more favorable formation before entering within battle range, and in that respect the advantage of a sudden and unexpected resort to reserve speed is clearly indicated. Direct movements will perhaps permit the quickest and best results to be obtained on such occasions; moreover, the object and resulting formation obtained by a direct movement, in which reserve speed is used, is hardly clear to the enemy until it is practically completed. This cannot be said of rectangular and successive movements. It is proposed in fact that however slowly a formation may *advance*, the *changes* of formation in the enemy's presence should be rapid. Nevertheless, with a raw or insufficiently drilled fleet, it seems advisable to adhere to rectangular movements and standard speed.

This makes all the more clear the importance of the *previous knowledge of plans* upon which Lieutenant Niblack has insisted. The *ability to execute them* may vary momentarily; it is dependent upon the rigor of the training and the effective organization of the *fleet*, however, rather than upon that of the individual ships. In fact, a thorough fleet training is absolutely necessary if it is hoped to profit by the advantages claimed for the defense of our coast by vessels especially designed for that purpose.

With regard to reserve speed. If all movements are to be successive, then it will be practically impossible to obtain the greatest efficiency under favorable conditions from all of our ships. In other words, various important battle characteristics in certain of our ships have been sacrificed to an extent in order to obtain a higher speed. If, then, we fail to make use of this greater speed, we are not fighting these ships to the best advantage; they have in fact lost not only prestige, but actual power on joining the fleet. The loss of what otherwise might have been increased gun fire or armor protection, which would thus be experienced by a large number of our ships should they be formed into a fleet, would be enormous. I would suggest as a preliminary formation that would make both armor and speed do their part in the fight, columns of divisions in line abreast. Let the heads of the columns be the best protected, and hence, perhaps, the slowest ships, the rear to be the fleetest, and thus most able to quickly change the formation. It seems almost axiomatic that all movements, in the immediate presence of the enemy, should as far as possible be based upon the slowest ships. The admiral must favor them in every way possible. If the battle is not joined in their vicinity, they may never get in it at all, or get in it too late. However he may use his faster ships to cloak his actual intentions, the final manœuvre should be such that the least loss results from the peculiar weaknesses of the different ships, and the maximum offensive power is brought to bear on the enemy.

It would seem that during the period of approach to the enemy more attention should be paid to tactics than to an effective delivery of gun fire from individual ships. The formation should be such as presents the greatest number of alternatives for engagement. The enemy is thereby rendered uncertain and puzzled; his movements can be most easily countered, and your own initiated. Of course get as much out of the guns as possible, but no really important advantage will be secured by long-range firing against an opponent who is at all formidable. The probability of hitting a ship bows on at 2000 yards range is of course great, the angle subtended by her beam being about 35°; but unless she is very weakly armored, the obliquity of the impact is so great that penetration will hardly be obtained except over unprotected surfaces. The angle of descent of the projectiles at that range is not sufficient to produce any material advantage from a "bows on" fire, and if the range is increased until any actual advantage is obtained from this angle of fall, the chances of hitting would become exceedingly small. On the other hand a very direct, and hence powerful, fire, with a plunging effect, may

be obtained when through unbalanced turrets the enemy's ships are heavily listed merely by training the guns abeam. There are a number of such ships in foreign navies; of course broadside engagements will be avoided by them and sought by their opponents. When listed, the belt on the near side is rolled under water, and that on the far side lifted out. In either case the machinery space is much exposed.

The unprotected portion of the target offered to the enemy when "bows on" is quite small; still if it is struck, it is possible that much more damage will be done than when the broadside is exposed.

As for the broadside position. The difficulty of seriously injuring a hostile ship which is on the alert and moving at a moderate speed, by ramming, is very great. It is not believed that special precautions as to formation need be taken to avoid this kind of attack by the enemy's line of battle. Any formation would, however, be thrown into confusion if it was necessary for the individuals to avoid rams; doubtless this will be the chief result accomplished by vessels of that description. While feeling the force of Lieutenant Niblack's objections to the échelon formation for slow ships, it seems evident that most of them can be overcome by the use of direct movements and reserve speed. Undoubtedly if an échelon be "attacked on its flank in the direction of its line of bearing, the fire of all the ships on that bearing is blanked." The same thing, however, can be said of a line. The échelon has the advantages of both line and column, with the disadvantage that a readjustment of distance is required if a change to either one or the other be made. Should the admiral with his fleet in échelon permit it to be attacked in flank, it would be little or no worse for him than if the mishap occurred when he was in line or column.

At the risk of taking up too much space in a digression, I must protest against the employment of the diagrams showing the arcs of train and energies of the guns of different ships as representing the efficiencies of their gun fire. It is granted that custom has sanctioned it, but it is nevertheless far from being correct. The fact is these diagrams, viewed in this light, represent the summation of an indefinite number of constant values or possibilities of energy, delivered under ideal conditions which continue over an indefinite period of time. Such a comparison would be of little value even if the work of our battle-ships was limited to bombarding defenseless cities or sinking peaceful merchantmen. For if the diagrams are true for one broadside, then they are not true for the other at the same time; if they are correct on any line at one moment, they cannot be correct on any other for a period of from one to six minutes. The diagram in fact merely conveys a limited amount of information which is seriously qualified by conditions of which it says nothing. The object of the battle is to produce changes, disastrous changes. in our adversary; and we know that we too will suffer from them—that some of our ships are more vulnerable than others and will suffer earlier and more severely.

There is not a ship designed but has its special features, its advantages and its disadvantages; and both in some ships are so glaring and im-

portant that doubt and appreciation, fear and favor, alternately claim our consideration. But so long as the attention can be kept riveted upon such diagrams of gun fire the designer's task is easy; it is merely necessary to multiply guns to compensate for lack of position; it is no matter whether the guns can be fired without mutual interference or not, for on that point, and on all others that affect their service, the diagram is discreetly silent.

It gives the low-lying 12-inch guns of the Puritan the same precision of fire and independence of sea conditions as those on the battle-ship Iowa. So far as the turrets themselves are concerned, those on the Iowa, being somewhat larger, may be hit more frequently; but the Puritan's face-hardened turret armor is but 8 inches thick, while that of the Iowa is from 15 to 17 inches thick. The diagram does not take that into account. Neither does it mention the fact that while the Puritan's ammunition supply is absolutely safe and that of the Iowa as nearly so as armor can make it, little can be said in this respect about the Texas.

It is true that in the Baltimore we have two bow and stern 8-inch guns, while on the Charleston we have but one, and therefore in a fight to the death against odds, should either ship lose her manœuvring power so as to permit an enemy to lie on each beam, the Baltimore would have a distinct advantage over the Charleston. Not that I think much of this advantage, since to produce the necessary conditions, both ships must previously have been either out-manœuvred or out-fought. There have been cases in our naval history where one of our ships has fought against great odds and even captured two of the enemy, but there is nothing to indicate that our captains permitted their opponents to choose their own position or take any advantage from their superiority in numbers.

The diagram does not recognize the very important fact that on the Charleston the one gun has twice the arc of fire of either on the Baltimore. This in itself, so far as precision and marksmanship are concerned, is a great advantage, especially when the target is near at hand and moving rapidly, as would necessarily be the case should the attempt be made to take vessels of the Baltimore or Charleston types at a disadvantage.

The fact is, the limiting lines of the arcs of the diagrams would be far from full length or sharp and clear if the *effect* of the energy, rather than its mere *delivery*, was considered. As the end of the arc of train is approached the marksmanship inevitably falls off, there is perhaps undue haste; certainly the full benefit of all the arc cannot be obtained. When the next gun takes up its duty, it is a lucky shot indeed that is well placed the instant the target comes into the field. These difficulties of course multiply with the subdivision of the field, but there would be nothing in these diagrams to show the difference between eighteen guns, each covering a successive arc of 10°, and a single gun capable of continuous train over the entire 180°. They do not show that a pair of 8-inch guns has been given the command of those on the Indiana, with an

ammunition supply as assured as that of the 12-inch guns on the Iowa, and that while the turret containing these guns is far smaller than that containing the 12-inch guns of the Puritan, the guns in the former would undoubtedly give a good account of themselves in a duel, although unequal to the task of *perforating* the latter's turret.

This is a time when on one hand a cry of alarm goes up against the cramming of our battle-ships with delicate and complicated means of interior communication, as if their possible failure would constitute a serious weakness not otherwise existing, and only to be avoided by denying ourselves these facilities. On the other hand, it is often stated that the fire control on the larger ships is almost certainly lost to the commanding officer on account of the distances and subdivision of the vessel. Not that I agree with either of these, for there seems no reason why the officers of the different gun stations and turrets should not be as well informed as to the commanding officer's wishes as those in the engine and steering rooms, except that the number of stations is great, and opportunity will be lost in the time required to transmit instructions rather than conventional signals. Gratitude must, however, be felt to the promoters of the design which, without sacrificing the fire of the guns, diminishes the important stations to one-third of their present number, making it in fact as easy to control the main battery of a great ship as it is the twin engines which propel her.

For want of a better arrangement these diagrams must be employed to represent the different ships in the war game, but only conventionally and with due consideration of the changes which would undoubtedly take place in the various ships as the battle progressed; for example, it may be expected that long after the supply of ammunition to the 8-inch guns of the Indiana is cut off and their turrets perhaps wrecked, the 8-inch guns of the Kearsarge will be as formidable as ever.

Ensign Philip Andrews, U. S. N.—Lieut. Niblack's exhaustive and clever presentation of the various questions connected with the conduct of a fleet in action will undoubtedly result in his primary object—of stimulating interest and discussion, and thus turning more minds toward a subject than which there is none more important for naval officers.

It is certain that modern naval tactics must be largely theoretical, as we have practically no modern engagements from which to deduce lessons.

In spite of warnings against applying the principles of military grand tactics to the tactics of steam vessels, I believe that this must be done. Broadly speaking, it seems logical to assume that fleet tactics (ships being practically independent of wind and weather) may be likened to the movements of masses of troops on shore.

The idea that the changed weapons of modern warfare demand widely different tactics from olden times is, I believe, what has led to so much divergence of opinion: one man favors the gun, or the torpedo, or the ram; the result is confusion.

The weapon of the past, and of to-day, is the gun, and so far more important is it than the ram or torpedo that it seems necessary to con-

sider battle tactics only with reference to the gun, since the use of the ram and torpedo in fleet actions will be only occasional and largely accidental.

The fact that the gun has increased in penetrative power I do not believe will invalidate the plain lessons to be drawn from the study of naval and military history and tactics of the past and the valuable object-lessons of battles of bygone times; for with the advancement of the gun has come protection to meet it (in the fighters), or speed for defense (in those that run away). The ratio of the elements of offense and defense continues to be about the same.

Taking up Lieut. Niblack's tactical propositions, it may be noted that he enunciates them "as the principles on which any scheme of fleet battle tactics must be developed."

Taking the first, it seems to me that the captain cannot possibly keep track of all the things counted necessary for him to know, or handle all the weapons which communication has placed at his hand. With the complexity of the present war ships the captain should occupy much the same position as the general of an army—his corps of subordinates, *within reach of his voice*, should control the ship and her weapons.

I would suggest that instead of boxing the captain, several officers and a helmsman in a conning tower with about fifteen things to handle, that an armored space similar to a turret be provided (of size suited to the ship), which would contain the means for controlling the ship and her weapons, and enough officers to carry out without confusion the captain's general directions.

The captain's mind should be freed from annoying details during the conduct of an action, and it would be better if he could not see the wheel or the other details usual in a conning tower. If he himself is stationed in a small conning tower communicating with, and directly over the armored space containing the means necessary to carry out his orders, he can more coolly direct his ship and give his orders. One officer might control the battery directly, another the torpedoes, another the position of the ship in squadron, etc.

We all know that the officer directing the movements of the ship should not be at the wheel himself, and on the same principle it seems to me that the captain's attention should not be distracted by any possibility of having to attend to any detail himself.

2nd proposition. I think all signaling in tactical evolutions should be by whistle or siren. Either can be heard to the limits of a good-sized squadron, as every officer knows who has heard the flagship at the head of a column in a fog.

The necessity for limiting the number of battle signals then largely disappears, as sound signals can be quickly made, and, if necessary, repeated from ship to ship. It is easy to have a number of whistles, in case one is shot away. I think we are all pretty well impressed in this squadron with the lack of success attained with flag signals, even without halliards being shot away.

6th proposition. I believe in direct movements, and only in rectangular

movements when you lack sea-room and time; but neither apply in the system of battle tactics to which I refer later on. When either a rectangular or a direct movement is necessary, I would prefer the direct, and believe (leaving aside the considerations of sea-room and time) that the objections to it are caused by lack of homogeneity of our war vessels, which should be remedied by gradually forming homogeneous squadrons of all classes as the Navy increases in size. No system of tactics can be evolved, nor one properly tested, in a squadron which contains the Montgomery and Columbia.

17th proposition. This seems the most valuable of all the tactical propositions. "Tactics should, by judicious formations, aim (b) offensively to reduce the tactical efficiency of the enemy by concentrating the attack on one or more of the units of his fleet, particularly on the flank, or on a manifestly weak part of his formation."

This is the backbone of all tactics, whether on land or sea, and should be a motto in preparing any system of tactics.

Captain Taylor, in a paper on Battle Tactics, in Whole Number 37 of the Naval Institute, points out the value of concentration, and suggests a solid square for the approach to the attack, in order that the principle of concentration may be carried out and the greater number of vessels thrown upon the less. This is the system of tactics which I think will prove the best, whether the solid square is the best form of massing or not; some massed formation will, I believe, be used for the advance to the attack, and deployment will be made for close action according to the formation of the enemy's fleet. I do not think that it will be possible, however, to deceive the enemy by feigning an attack on one point and then attacking another. That is a principle of military tactics made inadvisable by the fact that movements are too clearly seen and gun fire too unimpeded, and a feint simply means longer exposure to gun fire in a formation making a big target.

The 24th proposition, "that the best initial formation for the approach to the attack is *line in some form or other*," and the 3rd proposition, of the fleet in action on the open sea, "that a charge through, line to line, with the enemy, should be eagerly sought for, and tactically striven for," I believe is subordinating grand tactics to minor tactics, and that these are incorrect conclusions based on probably good premises.

The handling of a fleet worthy the name is grand tactics. The fact that steam fleets of to-day have the advantage in certainty of movement over sailing fleets but emphasizes the necessity of a system of grand tactics which does not include a charge through as a desideratum

In this connection I cannot do better than refer to an article "On the Study of Naval History" by Admiral Luce, in Whole Number 41 of the Naval Institute, from which I will now quote:

"For it should be remembered that in Howe's great battle of the 1st of June (1794) he exhibited no such fighting tactics as was afterwards practised by Nelson. With his accustomed exactness he formed his line with great precision and stood down for the French fleet, each ship steering for her opposite, with the intention that all should pass through

and haul to the wind, to leeward of the French line. There is no hint of crushing any one part of the enemy's force by overwhelming numbers; no indication of an intention of doubling on the van or center, or of placing the enemy between two fires. It was simply the old custom of placing ship against ship, and allowing a great fleet fight to resolve itself into a series of single engagements. The result was the customary indecisive battle, and consequent popular dissatisfaction. Howe, then, was not a tactician in the sense that Nelson was. . . .

"Minor tactics change with the change of arms or improvements in naval architecture. Not so with grand tactics. But whether it was Phormio or Agrippa or Russell, a Nelson or a Perry, the victory has generally been with that leader who had the skill to throw two or more of his own ships on one of the enemy. That is one of the most valuable lessons of all naval history, and that, it may be stated here, is one of the fundamental principles of our science. It is the capacity to carry out that principle that gives evidence of the skillful tactician. It is the ignoring of that principle that serves as one of the most impressive warnings of naval history. . . ."

The excellent chart of diagrams of gun fire which Mr. Niblack has prepared, with the cost of the vessels represented on the same sheet, would be excellent material to use on Congress as an argument in favor of battle-ships, and we would have no more Columbias. Such commerce destroyers would be supplied by the merchant marine.

The use of language as an expression of ideas by one, and the understanding of it by another, being often different, I must confess that I am not entirely clear as to all of Mr. Niblack's propositions, and seem to find occasional contradictions in them. It is more than likely that my criticism—where criticism is found—is due to not entirely catching the meaning intended.

Captain H. C. Taylor, U. S. N.—An active mind working upon a professional topic of such importance as naval tactics must always produce results of interest, and the more so if the topic is one that has hitherto been neglected. It is not possible to touch upon all parts of the extensive field which our essayist covers, but a few remarks may not be out of place, coming from the Naval War College, whose interest in tactical questions increases as the subject is better understood. The diagrams by which Lieutenant Niblack illustrates the values of the different arcs of fire from typical ships in our Navy are destined to be of much service in working out questions of tactical formations, and it is found at the College that these diagrams repay long and attentive examination.

As to the indented line, there are some who believe that no object is gained in thus forming the line, and that the natural irregularity of the best formed line or column in the open sea is so great that the effort to indent it would produce greater confusion, and is, in fact, a striving after too fine a result in the case of great ships, rough seas, and the confusion of battle.

The essayist's plan of charging through in columns of sections has, I believe, much to recommend it, and the principle might perhaps be carried further. It has been suggested that a line of nine ships should charge in three columns of three each, sixteen ships in four columns of four each, or in such proportions as may be found desirable with varying speeds and different classes of ships.

I will not attempt to touch upon all parts of this excellent essay, and will only say that it shows throughout that a thorough examination of tactical questions has been made and that the conditions of naval warfare have been kept constantly in mind, resulting in the production of a most valuable professional work.

Lieutenant Niblack will, I am sure, permit me to suggest the advisability of extending and enlarging our idea of naval tactics and of including in it something more than questions of line, column, evolution, and the relative places of ships and their distances and lines of bearing. We recognize that there is something more in the tactics of armies than questions of depth of lines of battle, positions of artillery, and how cavalry shall be placed. These are not tactics themselves, they are only methods of carrying out a controlling tactical idea.

These ideas or governing principles of tactics, though few in number, are of various and diverse application as influenced by conditions of configuration of ground, hills and rivers, and by natural obstacles and strongholds.

It is very desirable that naval officers should give their minds to a full consideration of similar conditions in their effect upon the tactics of fleets. There will be little opportunity for this in open sea fighting, though even there the larger tactical principles must be first considered; but we may reasonably expect a great proportion of fleet battles under steam to be fought under such conditions of adjacent land and shoals, channels and islands, as to make their success largely dependent upon the advantage taken of these circumstances.

I would suggest to the essayist and all officers, therefore, to give much thought for the next few years to the broader field of tactics, in which must originate those primal laws which are to guide us in the choice of line, column or échelon, as well as in all the other numerous details of tactical drill.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

SPEED CONTROL IN MODERN STEAMERS.

By Lieutenant M. L. Wood, U. S. Navy.

When steam was applied to the propulsion of vessels, the control of the speed was effected by means of verbal orders passed along the deck to the engine-room. The boys employed on board the early passenger steamers in the Thames seem to be conspicuous in the accounts of travellers in those days.

In ocean steamers a system of communication was gradually developed which was in general use up to within a few years. This consisted of signals transmitted by ordinary bells, of which two were used, one a single stroke gong and the other a "jingle bell." The signals in common use were as follows with the single stroke bell: 1 bell (when stopped), "ahead slow." 1 bell (when going ahead full speed), "slow." 1 bell (when going ahead slow or backing), "stop." 2 bells, "back." The jingle bell indicated full speed on engine whether backing or going ahead. It was also used to indicate "stand by the engine" or "through with the engine." This system has stood the test of extensive practical use in all sorts of vessels, giving satisfaction until the introduction of more modern means. It will be noticed that the meaning of the signal depends upon preceding signals and the action of the engine at the time. A slight lapse of memory or of attention at critical moments might result in misunderstanding the signals for working the engine, with possible damage to the vessel itself or to others in close quarters.

The extent to which a system of sound bells can be developed is shown in some of the western river steamers of the United States. The old Mississippi River steamers, where the strong current, sharp bends, frequent eddies, with the necessity for stop-

ping, in case of a hail, at almost every plantation-landing with the bow up-stream, have a very efficient system which serves admirably for handling vessels under exceptionally difficult conditions, and, incidentally, as an example of extreme complexity. The larger river steamers were side-wheel, with each wheel actuated by a separate engine controlled by a complete set of signal bells. For each engine there were "go ahead," "stop," "back," and "slow" jingle bells; there was also a "shifting" (single stroke) bell to indicate reversing the "hooking-in" valve gear when the next signal would require a change in valve motion. This would seem complex enough, but, in addition, each bell had double pulls in the pilot-house, so all the bells could be worked from either side of the wheel. Besides these there were also bells to the firemen to "open doors" and to "fire up," and to the gang-plank engines, with voice-tubes to engines and other parts of the boat. The whistle was worked usually by a treadle or foot lever.

All this was manipulated by one man—the pilot—who, in addition, handled the steering-wheel alone, unless he had an apprentice—called a "steersman"—temporarily under his instruction.

To enable one man to steer the large steamers along their devious track, the steering-wheel was made large, ten to thirteen feet in diameter, with the axle below the floor of the pilot-house.

This was the system in use on the Mississippi river in the palmy days of the trade, and is still in use, with few changes, at the present day.

One peculiarity of this system is that every signal to the engine signified "full speed" unless accompanied by a "slow" bell. The signals are nearly all "positive" in their meaning, as they do not depend upon preceding signals.

In spite of its apparent complexity, this system of engine control certainly served its purpose, as the engines were worked with a promptness and certainty that resulted in the delicate and efficient handling of the vessels necessitated by the conditions of the trade.

In the older steam vessels of the U. S. Navy, including those yet in use at the present day, a system is in use differing from both those described, as it makes use of but one single stroke gong. With this system, 1 bell, "ahead slow"; 2 bells, "stop"; 3 bells, "back"; 4 bells, "ahead full speed." The advantages of this system are: that it requires but one bell, saving the cost of

the second bell and the wiring, and also that the signals are positive, having but one meaning, irrespective of preceding signals.

The principal disadvantages are: that it is noisy, hard upon the bell connections, that it is liable to fail at critical moments if signals are given under excitement or by an unpractised hand; that it is slow, as time must be lost waiting to see if there be a following stroke, which may change the signal completely; if obeyed too quickly and therefore improperly, hesitation or doubt is produced by the attempt to go ahead and back at the same time; that the first two strokes of "4 bells" is often mistaken for 2 bells, with the result that the engine is partially slowed, or even stopped, when "ahead full speed" is required to avoid accident; last but not least, there is no provision for backing full speed, which may be the only means of averting danger.

In fact, the "4-bell" system is about the worst in use anywhere. Its disadvantages come out strongly in the case of smaller vessels making frequent landings, and in these it is usually avoided by the adoption of the merchant code whenever practicable without attracting official attention.

There is a system of signals to the engine-room suitable for use on board vessels where it has not been deemed expedient to fit modern engine-room telegraphs, which has been developed probably by accident, but which has stood the test of practical working wherever tried. In this, two bells are used, a single-stroke bell and a jingle bell. The signals are as follows: 1 bell, "ahead slow"; 2 bells, "stop"; 3 bells, "back"; jingle bell, "open throttle," *i. e.* "full speed" on the engine whether going ahead or backing.

The advantages of this are numerous enough to warrant its adoption on board all vessels of the Navy not fitted with engine telegraphs. The signals are all "positive," since they do not depend upon preceding signals. The reliability of the bell is improved, as it does away with "4 bells," with its chance of breaking down or of confusing signals. It also furnishes the important signal "astern, full speed," which is an important one. The only change required to introduce this system would be the placing of a second bell on board vessels. This expense will be very slight compared with the lessened risk of damage due to more efficient handling.

In all these systems using sound codes the only information given to the pilot-house as an indication of the proper transmission of the signal is the sound, assisted by tubes, of the bell itself, which for this purpose is much louder than would otherwise be necessary.

In modern steamers the necessity for quicker and more reliable signals to the engine-room has developed the use of engine telegraphs, using visual signals in place of sound signals. As at present in use on board all, or nearly all, modern steam vessels, the engine-room telegraph, whatever may be the special design, consists essentially of a small lever moving over a dial on the bridge connected by various mechanical means with a pointer in the engine-room, whose motions are made to correspond exactly over a similar dial. Each position of the lever with the corresponding motion of the pointer indicates a signal and rings a bell to call attention. The signals transmitted are as follows: "Ahead, full speed," "three-quarters speed," "half speed," "slow," "stop," "back slow," "half speed," "three-quarters "speed," "full speed astern." Sometimes other intermediate signals are used. The indication that the signal has been received is a return signal made by a lever in the engine-room which moves a pointer over the telegraph dial on the bridge repeating the signal and acknowledging the receipt of the signal to be carried into effect. The motions of the propeller shafts are shown by indicators in the pilot-house which indicate the motion and the direction of motion of the engines.

There are several designs which work efficiently upon the principles stated generally above. Their working is shown by thorough tests in service which demonstrate their utility. It will be noticed that the signals are greater in number than with the bell codes using sound signals, thus giving greater delicacy in handling vessels than was before thought possible or deemed essential.

The management of the helm has also been developed. Vessels were steered by a tiller on the rudder-head by hand-power directly applied, until the increase in size of ships led to the adoption of a steering-wheel to give increased mechanical power over the movements of the rudder. The shifting of the steering-wheel to the forward part of large steamers for convenience in

handling, necessitated longer wheel connections with increased friction, which in turn led to the use of engines for controlling the rudder. After many attempts, lasting through many years, the present systems of steam steering gear have been developed. The difficulties of the problem were great. A heavy rudder, in large vessels, weighing thousands of pounds, exposed to violent shocks from waves, was to be moved either by slight changes, starting from any position, or rapidly, from one side to the other. This motion had to be under perfect control, since the rudder was, by the conditions accompanying its use, required to follow exactly the motions of the steering-wheel on deck. Too much motion of the rudder was as bad as too little, since its duty is to steer a large, fast steamer to degrees of arc on her course, or, on the other hand, to change direction suddenly to avoid danger. These mechanical difficulties have been completely overcome, there being several designs of steam steering gear which can now be relied upon in every respect.

The general design of all the patterns is about the same, the principal differences being in the means used to attain the end. Steam steering gear in general is as follows: A small steering-wheel in the pilot-house, or on the bridge, in the forward part of the vessel, is connected by shafting and gearing, wire ropes, or combinations of both, to mechanism moving the valve of the steam steering engine in a compartment near the stern; this valve admits steam to the cylinders revolving the drum in the direction decided by the motion of the valve. A small motion of the valve produces a small motion of the drum connected with the tiller by chains or gearing.

This limitation of the effect is produced by a " stop motion," differing in different systems, in which a lug or projection attached to a cut-off valve follows the valve by the revolution of the drum until it catches up with the valve, when it stops the engine and, therefore, the tiller, by shutting off steam. It will be readily seen that the devices to produce this effect are necessarily too complicated for description here. They, however, have been found to do their work properly and are thoroughly reliable. When the small wheel in the pilot-house is moved slightly, the rudder makes a correspondingly slight movement, stopping in the new position, held firmly by the steering engine until the next movement of the steering-wheel. The serious

damage that would result to the pockets of the owners, and to the vessel itself, from erratic working of the steering engine in a crowded harbor can be easily imagined. This has resulted in the steam steering engine having been brought to such a stage of perfection in several patterns that it can be safely locked up in its compartment, after proper adjustment, with confidence that it can be relied upon to do its work for hours at a time. All steam steering gears are provided with arrangements for being thrown out of action in case of failure to act properly, but the cases of failure to work, when well installed and attended, are very few and far between.

As the movements of the rudder of a large vessel in a heavy sea are extremely violent, all parts of the steering engine are made with large factors of safety to withstand the sudden jerks.

From the above it would seem a settled fact that the commercial steam steering engine can be relied upon to move the tiller in any weather in exact accordance with the movements of the steering-wheel at the other end of the vessel.

To return to the discussion of control of speed. The question naturally comes up, Why is it not practicable to connect the engine telegraph, or a modified form of it, suitable to the new conditions, directly to the mechanism controlling the direction of motion with the speed of the engine, so as to work the engines directly from the pilot-house instead of from the engine-room platform?

It is the object of this paper to show that such a connection is practicable, that it can be made reliable, and that it is advisable, on the score of efficiency, by eliminating chances of error in transmitted signals, with increased rapidity in working engines, while preventing damage to engines and lessening the chance of accidents, by allowing constant general inspection while under way by those now stationed to work engines by hand in obedience to signals.

The following is the plan proposed for adoption without interfering with working the engines exactly as at present, when so desired. When the principle is once adopted, simplifications can be easily arranged, lessening the number of parts to suit the size of vessel and the different types of engines:

1st. Connect the engine-room telegraph, modified to suit the work, or a special connection designed for the purpose, to a small pinion or suitable gearing, which will move the valve of a small commercial steam steering engine the full extent of its throw, by the movement of the lever in the pilot-house, the motion being so adjusted that the "stop" position of the lever agrees with the position of the valve for "helm amidships." For convenience, call this small steam steering engine the "regulator engine." The pattern is immaterial, only the valve must be specially designed to move with as slight friction as possible, owing to the small travel of the lever.

2d. In place of the drum on the regular engine, fit a shaft, which, by worm and gear or rack and pinion movement, will move a frame sliding in horizontal guides, exactly as the tiller end is moved by a steam steering engine—the middle part of the travel of the frame corresponding with the "stop" position of the lever in the pilot-house and with the "amidships" position of the valve of the steam steering engine used for the regulator engine.

3d. To the frame, called for convenience the "regulator," attach two vertical stiff plates. One of these plates has guide pieces riveted on, or a slot cut, in which a cam, moving in vertical guides, slides. This cam is connected with the valve of the ordinary reversing engine governing its motion. The other plate is connected in precisely the same manner with the main throttle valve. The motion of both cams is controlled by the shape of the slots in which they work, thus regulating the position of the valve of the reversing engine and also the position of the throttle. For every position of the "regulator" there is but one position of the throttle valve and one position of the reversing engine; also these positions will be exactly those required for the most efficient working of the particular engine.

During the middle third of the travel of the "regulator," the direction of motion of the engine is controlled; the outer parts of the travel regulate the speed from "slow" to "full speed" with any degree of nicety required.

In this connection it will be noticed that the motion given to the sliding frame, or "regulator," and the power available for moving the main throttle valve with the reversing engine are both practically unlimited, as both depend only on the power of the

steam steering engine, having no relation in amount to the force exerted on the lever in the pilot-house.

4th. Arrange simple accessible means for throwing the automatic engine control apparatus out of action on the shortest notice, allowing the engine to be worked by hand as at present, using exactly the same principle by which the steam steering gear is disconnected, leaving the tiller to be worked by hand in case of necessity.

The consumption of coal, the amount of steam used, with the speed constituting "full speed" for the time being, will remain entirely under the control of the chief engineer, as at present.

There is one mechanical difficulty that interferes with this plan at present. It is believed that, as soon as called for, a way will be found for its elimination. All steam steering engines are designed for use with a wheel in the pilot-house, making one or more turns to move the valve of the steering engine its whole travel. This has allowed a worm and gear motion to be applied to the valve stem, so that the power available for moving the valve is great, and, therefore, in all steering engines no particular attention has been paid to reducing the power required to move the valve. The plan proposed for using these engines as regulator engines will require an easier movement of the valve than is usual with commercial steam steering engine valves. Manufacturers will be able to produce easy moving valves when once in demand; the more readily that as the regulator engine in this plan has to move only two light valves instead of a heavy rudder subjected to violent jerks, a very small, lightly made steam steering engine will handle the engines of the largest battleship.

Let it be assumed for the time that the friction and resistance to motion of the valve of a steam steering engine has been so reduced by good workmanship, with properly designed valves, that the motion of the pilot-house lever of the ordinary form of engine telegraph through an arc of 90° will give a motion of six inches, the whole travel, to the valve of a small "regulator" engine in the engine-room. Then it necessarily follows that the sliding frame or regulator can be made to follow the motions of this valve exactly, by means that are thoroughly tested and reliable. Suppose the drum of the steam steering engine be attached to the shaft shown in *SS*, Fig. 1, which, by means of the worm

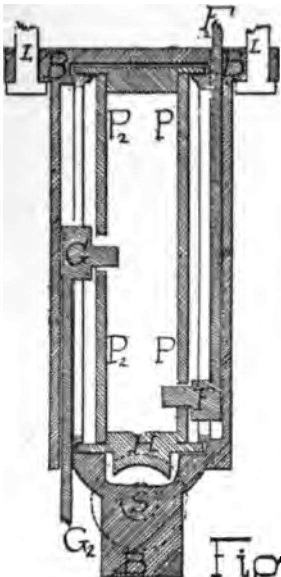


Fig. 2

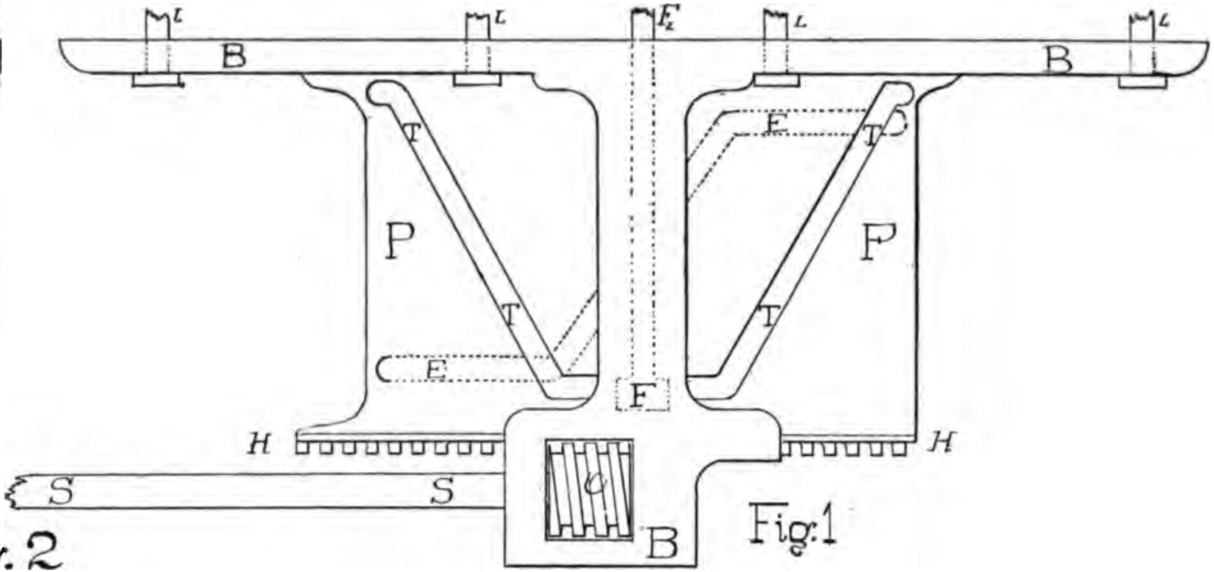


Fig. 1

AUTOMATIC ENGINE-CONTROL
REGULATOR

wheel *O* and the cogs *HH*, gives a rectilinear motion of say three feet to the plates *PP* and P_1P_1, sliding in bracket *BB*, Figs. 1 and 2. The movements of the rod F_1 connecting with the throttle are governed by the guiding slot *TT* and cam *F*, Figs. 1 and 2. The movements of the rod G_1 connecting with the valve of the reversing engine, or, preferably, directly to the links of the main engine, are governed by the guiding slot *EE* and the cam *G*, Figs. 1 and 2, in the plate P_1P_1, Fig. 2.

(Two separate guide slot plates are shown to bring out principle.)

The figures show the regulator in mid-position with the steam shut off and the links half up.

In the sketch the guide-slots are shown as parts of straight lines, for simplicity; they would in practice be easy curves to give best results. The shape of the slots and their relations to each other would be determined by the particular type of engine, but would be designed for the most efficient and safest handling. The speed of the regulator could also be governed so as to prevent reversing too quickly.

The location of the regulator engine would be such as to allow the shortest and simplest connections with the engine-room telegraph. It could be under the engine-room floor or where least in the way. The location of the sliding frame would be close to the engines, where least in the way, against a bracket shelf on a bulkhead, under the engine-room floor, or overhead—the location, except for convenience, being immaterial, as it is to be moved by gearing and shafting from the drum of the "regulator," which can be given all the power needed. The motions from the cams to the reversing engine and the throttle are communicated by bell-cranks or other suitable connections.

To the regulator may be attached projections which will ring as many bells as required at every change of speed, with arrangements for disconnecting all bells when quiet is desired, as in seeking or avoiding an enemy in a fog or in the dark. Bells governing the firing under the boilers can also be worked for routine changes.

The auxiliary machinery, such as circulating and air pumps, can be controlled with but little trouble by additional slots and cams. In fact, all routine movements now performed by hand

successively can be arranged to take place at the exact time required for efficient working without the possibility of mistakes.

Speed recorders can also be attached to the "regulator," which will give "hodograph" or speed curves, as decided by the position of the throttle, on a slip of paper worked by clockwork and tracers, using the principles of the "barograph" and ordinary engine "indicator." This will avoid the necessity for constant notes of changes of speed, while it will give an accurate record for a watch or for a week, from which the important data may be taken for entry in the log-book.

The speed of the regulator with the movements of the throttle can be so adjusted by experts that the possible danger to the main engine which might result from carelessness or incompetence in working by hand, can be entirely avoided. Even the water-valves may be opened automatically in starting the engine from rest.

No provision is made for the sending of any return signal to the bridge while working automatically, as the motion of the engine will show on the "engine indicators" in the pilot-house, and will be the best and surest indication that can be devised. When the automatic control is disconnected, the motion of the answering pointer on the engine telegraph will then be in operation and will serve as a signal that such change has been made.

In case it be assumed that the engine telegraph cannot be made strong enough, or the friction of the valve with its resistance reduced sufficiently, the valve on the regulator engine can be made to move by a lever of sufficient power, connected with the valve by means similar to, but lighter and simpler than the connections to the steering engine in the steering engine compartment.

If the plan has been carried out properly in the original design, as long as all parts were in adjustment with everything working properly, no more care or attention would be required by the regulating engine than by the steering engine. It would be possible to lock it up, with only occasional visits for inspection. The work of the regulating engine would be less frequent than that of the steering engine when under way, besides being also much lighter in character. There seems no reason why it should receive any more attention or require even as much care. In case of anything not working properly or any adjustment being

required to either regulator or main engine, or in case of accident, the regulator can be disconnected, throwing in operation the usual engine-room connections to the engine telegraph. As soon as put in order, the regulator can be thrown in action. An emergency throttle can be used to shut off steam suddenly from the engine-room. While getting up steam the regulator engine and its connections can be tested and reported ready for use in precisely the same way that the steam steering gear is tested and reported at present.

The primary object of the automatic working of the main engines directly from the deck is increased efficiency. Time will be saved by its use, as well as the elimination of the chance of accident from misunderstanding or faulty execution of signals. Such mistakes have happened with the best men at the throttle and may happen again. The power of working the engines at all times may be of vital importance. A small piece of a projectile during battle might cut even a small auxiliary pipe filled with live steam, which might make an engine-room uninhabitable before steam could be shut off. The destruction of the draught might fill the compartment with poisonous gases. During the time the engine-room was thus cleared of living beings, might occur a critical moment when the safety or destruction of the vessel would depend on the handling of the engines promptly. The plan proposed would allow the engines to be controlled the same under such conditions as at any other time.

In a vessel dependent on the motion of the engines for propulsion, the importance of the proper working of the machinery at all times, but especially in action or in times of danger, cannot be overestimated. A collision or a torpedo explosion might result in such danger to those below decks that the engine-room would be cleared on account of the possibility of going down with the ship. Control of the engines from the deck would prevent the loss of life due to the vessel sinking while going through the water, or carrying down those remaining at the post of duty in the engine-room.

This suggestion of automatic working of the engines of a vessel of war from the deck is not intended to lessen the responsibility of those in charge of the machinery, although it incidentally makes the work easier by giving relief from the suspense

of waiting for signals which do not come, and by allowing freedom of movement to inspect the proper working of all parts of the engines. In fact, it will really add an additional machine or two to be kept in order and in adjustment, to the already large amount now on board modern vessels of war.

It is intended to increase the efficiency of the vessel by quicker handling of the engines directly by the movements of one lever, by the elimination of chances of human error in carrying signals into execution, and by allowing those on watch in the engine-room, when under way, freedom to inspect bearings or detect imperfections in the working of the machinery in time to take steps to prevent accidents or delays. In the case of a twin-screw vessel it really adds at least two—presumably the best in the watch—to those available for general inspection of all parts. It is not considered necessary to have an expert standing by the steam steering engine when working the rudder, and it will not be considered necessary to have an expert standing by the same engine doing very much simpler duty in the engine-room.

That it requires a higher order of intelligence to keep machinery in order or to design new appliances than it does to reverse an engine or handle a throttle lever in answer to signals, is so self-evident that no apology is deemed necessary for suggesting automatic speed control from the deck to those in charge of the designs of vessels of war.

Various changes will suggest themselves to experts looking over the details of the plan here proposed for speed control. The details as given may appear cumbrous, as the one idea has been to make the principles clear, and this could be done only by sacrificing small details to bring out the general effect. Keeping the reversing engine available for use when desired has also added unnecessary parts. The reason for these defects in the plan is obvious. When once the principle is adopted there will be time and opportunity for introducing improvements in many directions to save room and get rid of useless parts. The regulator can move vertically if horizontal space is scarce, or the worm-gear can be on top if desired. As suggested in this paper, with only minor changes to give more compactness, it can be adopted and installed in existing engine-rooms with but little loss of space. When part of the original design, it can be still further improved by combining regulating with reversing engines, with many other simplifications.

The sketches accompanying this paper are, therefore, to be considered as designed to exhibit principle and not for actual construction. The proportions are chosen to show parts, and not the exact sizes of those parts or their relations to others.

The practicability of working the regulator or even the engines by other than hand power or steam is not considered sufficiently tested to warrant its recommendation. When vessels are steered by electricity as much as they are with steam, it will be time to use that method of handling engines, and by the same mechanism used to control the rudder.

The location of control points on board a man-of-war is an important question. In general, for fighting purposes, conning-towers will be placed as far forward as possible where the view ahead is least obstructed. On the other hand, the efficient working of the guns requires that the gun fire shall be unobstructed. The chance of being hit by enemy's projectiles calls for a low position, with a shape to resist serious damage as much as possible. The compromise will probably be that the conning-tower will be hemispherical, with a tunnel entrance from the upper deck, and that its location will be abaft the forward guns and forward of the mast and smoke-pipe. It will probably have just enough elevation to allow the view to be unobstructed. A second conning-tower will probably be placed in a similar position aft. It may also be deemed advisable to have a conning place in an armored top on account of the many advantages of the elevated position. When not in action, a well equipped bridge, pilot-house and chart-room will be located about in the position given above to the forward conning-tower. These questions, involving the exact control points, will be determined by the type of vessel and need be no further considered in this paper, since wherever the engine telegraphs are located in the design of the vessel the same leads and connections would be suitable for the automatic control of the engines from the same points, with the same appliances for throwing out of gear the apparatus not in use at the time. Any point suitable for an engine telegraph will be equally suitable for the use of automatic control from that point.

This plan of automatic control of engines from a distance, besides being adapted for exact and delicate handling of vessels, is also applicable to handling turrets. The lever being in the

turret, where most convenient, with the engine working the turret below out of danger and where it will give the best results. The connections being the same as at present, by means of a sliding collar on the spindle with a diminutive regulator below the turret, as described for working the main engines. The regulator could be overhead, and its travel, with accompanying delicacy of handling, arranged to any degree of fineness desired. As all the working parts would be small, many parts could be combined, with resulting compactness. The turret could be made to move as slowly as desired without jerking, owing to the regulation of the amount of steam, or as rapidly as the engine could work safely,

The following is a résumé of this plan for the automatic control of the main engines of a vessel of war:

1st. The use of as direct and as frictionless connections as practicable for transforming the motion of a lever in the pilot-house into motion of the valve of a small, light-working steam steering engine used as a regulator engine in the engine-room of the vessel, so that the valve follows exactly the motion of the lever.

2d. The following of the motion of this valve of the regulator by a drum, exactly as is done by the steam steering engine.

3d. The transformation of the motion of the drum of the regulator engine into the rectilinear motion of a sliding frame or regulator, so that the latter follows exactly the motion of the valve and, therefore, the motion of the lever, but over a longer space and with more power, in the same manner that the tiller and rudder follow the motions of the steering-wheel.

4th. The transformation of the motion of the regulator to motions of two rods, one of which controls the motion of the valve of the reversing engine, or the links of the main engine, and the other controls the position of the throttle valve of the main engines. This also produces the motions requisite for ringing bells anywhere, and for starting in operation and slowing auxiliary machinery necessary to and dependent upon the working of the main engines, to any extent deemed advisable.

5th. Readily accessible means for throwing the automatic control out of gear, leaving the engines to be worked exactly as at present.

As to its originality, it can be said that the plan proposed is original with the writer in so far as it is applied to handling of

engines on board large vessels by means of the steam steering engine principle. That is believed to be entirely new and is believed to be the keynote of success. As to the idea of working the engine direct without a second man to receive a signal, that is done in thousands of locomotives in every-day use. As a matter of fact, it will require less manual power in the pilot-house of a large steamer to work the engine by means of the regulator described in this paper than it does to work the massive lever in the cab of a railway locomotive, in spite of the longer connections and the greater size of the vessel's engines.

The locomotive idea has been applied to direct working of the engines of small vessels with double engines, and there are several patented devices in successful operation.

I know of no patents, existing or future, covering the ideas advanced, and think the plan capable of development.

The following are some of the advantages which would attend the adoption of automatic control of engines:

1st. Avoidance of errors and accidents due to misunderstanding or poor execution of signals from deck.

2d. Quicker working of the main engines, since the motion of one lever on the bridge acts directly on both the reversing engine and the throttle. The engine will be worked in the same time it now takes to make the signal.

3d. Complete control of the engines while steam is in the boilers, in case an accident to a steam-pipe or the draught makes the engine-room untenable, or a serious incident, such as being rammed or torpedoed, forces those in the engine-room to leave their post.

4th. Greater efficiency in handling the engine with increased security from accidents due to imperfections in machinery or its working, by allowing those now stationed strictly on the engine platform when under way to move freely about the engine-room, inspecting all parts more frequently.

5th. Relief from constant strain of those now stationed to watch engine-room telegraph when under way.

6th. Adaptability to any form of engine without lessening usefulness of present system of reversing engines by hand.

7th. Ready return to existing style of working engine when so desired.

8th. Adaptability of present connections of engine telegraph to new system of working engines without any increase in number of parts or the use of untried systems of connection.

9th. Exact and delicate adjustments of speed to suit the exigencies of squadron evolutions in close order.

I offer this plan with a great deal of diffidence for discussion by the Institute, and in the hope that something may be done to develop an idea in what I believe to be the right direction. No one has ever complained of the introduction of small engines in place of manual power for reversing ships' engines. This plan, with all of its imperfections, is a further step in the same direction. It is bound to come, and the sooner the better.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

A SYSTEM OF AIMING DRILL.

By Ensign Philip Andrews, U. S. Navy.

Blunt's Rifle and Carbine Firing contains many valuable suggestions and rules for target practice with small arms, among them the following exercise for sighting:

"Sight three times at a movable target which is each time brought into the line of sight without moving the piece." Following this rule, the triangle drawn through the three shots, if small, will indicate regular, but not necessarily correct sighting, since there may be a constant error. Blunt recommends that the instructor, after drawing the triangle, himself see whether the center is in the line of sight; but this affords no criterion, since the instructor's aim may be no better than the man's.

The following method of sighting drill is believed to be an improvement on this method. It was first suggested by the writer in 1891, and was then used on the Chicago, and has since been used to some extent.

The target board and rifle should be fixed throughout the drill in absolutely the same position.

Let each man sight three times at the movable target after he understands theoretically how to sight.

Connect his three shots so that they may be identified, and number the resulting triangle.

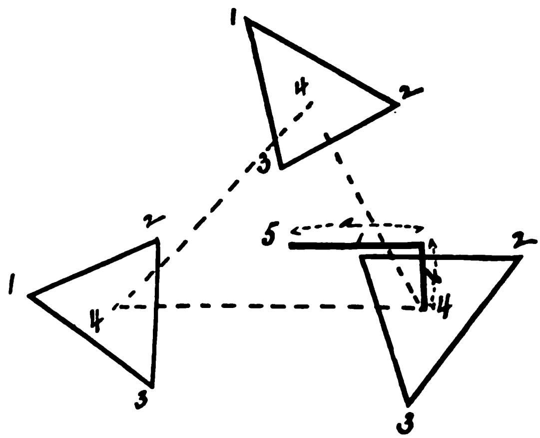
The number of shots given each man is immaterial, as the mean point of impact of his shots can be readily found, but three shots will be ample.

After ten or more men have shot (and about ten shots will be a long enough drill), find the mean point of impact of all the shots fired. This point will be almost exactly where the sights

of the rifle really point, and is certainly much more accurate than the sighting of any one or two men.

The mean point of impact of the shots of any one man compared with the position of the mean point of impact of all the shots will show what the errors of that man are, whether his sight is coarse or fine, and whether he sights from one side or the other of the rear sight.

The following figure illustrates roughly the method to be followed:



1, 2 and 3 show three shots of any one man.
4, 4, 4, show mean point of impact of the three shots.
5 shows mean point of impact of the shots of a number of men.
a shows horizontal error of a man's shooting.
b shows vertical error of a man's shooting.

This method shows with considerable accuracy the absolute errors of sighting, its accuracy increasing with the number of shots taken.

An approximate idea of the progress during drill may be had by having the best shots start, to correct glaring inaccuracies of aim in those following.

Experience shows, however, that the same man, from carelessness or other cause, does not sight the same from day to day, so this brings up the subject of records for each man, to finally show, after a reasonable number of observations, what his usual errors are.

This may be done in two ways:

First—By keeping a tabular statement of each man's vertical and horizontal errors from the mean point of impact each day and averaging them, say weekly or monthly, in the meantime making daily corrections of evident inaccuracies in aiming.

Second—After the usual determination of the mean points of impact of each man and of all of them, place each day's final mean point of impact (the point at which the rifle aims), coincident with the bull's-eye of a figure of a short-range target (which for convenience may be on transparent paper) and mark each man on the scale of 5 for a bull's-eye, and 4, 3 and 2 for the other rings.

The figure of short-range target should be of a size proportioned to the mean vertical and horizontal deviations of the rifle used at the distance selected.

The second method furnishes an excellent record of a man's general improvement, but would not show the components of his errors; the first method would seem to be preferable for purposes of correction, since it shows a man's vertical and horizontal errors; and thus, after a reasonable number of shots, just what kind of a sight a man uses.

I have found that a long range is preferable to a short one, the aiming appearing to be about as good at 100 feet as at 50, and that the competition among the men, by having them understand the system and appreciate the comparison it makes, engenders a spirit of rivalry akin to that in real target practice.

It may be pointed out that aiming drill may be profitably had with a 6-pdr. or 5-inch gun on poop or forecastle, or with the turret guns, clear spaces of 30 to 100 feet being generally obtainable.

Aiming drill is beneficial for general sighting improvement, but the main and secondary battery guns should be used, where practicable, for sighting drill, to improve the aiming of these weapons.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

HONORABLY MENTIONED.

MOTTO: "Historically, good men with poor ships are better than poor men with good ships."

THE ORGANIZATION, TRAINING, AND DISCIPLINE OF THE NAVY PERSONNEL AS VIEWED FROM THE SHIP.

By LIEUTENANT WM. F. FULLAM, U. S. Navy.

It is admitted that the personnel of the Navy should be reorganized. At the last session of Congress a joint commission was appointed to investigate the matter. The commission devoted much time and study to the subject, listened to the views and claims of all classes, and took a large amount of testimony representing all shades of opinion. From a careful review of the proceedings of the commission, it would appear, with all due respect, that considerable time was given to the consideration of recommendations having a very remote bearing, if any, upon naval efficiency. The claims of individuals and classes were urged with greater energy than were the demands of the Navy as a whole. The interests of distinct corps were pressed to the front with a persistency that often sent the consideration of general fighting efficiency to the rear, or hid it beneath a load of bewildering arguments.

Notwithstanding the fact, however, that some of the most important elements of naval efficiency were obscured by irrelevant testimony, the commission demonstrated that it had in many instances carefully weighed the conflicting claims put forth by corps and individuals, and had formed an intelligent and generally correct idea regarding many points that have been the basis of contention for years.

But after the testimony was all in, the verdict of the commission—the jury before which the case had been exhaustively tried

—was not satisfactory to many individuals and classes. The bill formulated by the commission contained certain provisions that would undoubtedly bring hardship and disappointment to some officers, who could not, therefore, reasonably be expected to advocate its passage. In such cases concessions should be made if possible. But there were others who opposed the bill, and who openly boasted of their determination to kill it, not because it injuriously or unjustly affected them, but because it did not grant them concessions which in some instances would be mischievous and injurious to the service at large. In such cases opposition was unjustifiable, and compromise would therefore be inexcusable. There is a limit beyond which the claims of individuals must not take precedence of the claims of the service.

It is in this phase of the question that we find the most serious obstacle to naval reorganization. The tribunal whose judgment is to be final must distinguish carefully between personal rights and service rights. Harmful precedents and selfish personal schemes, pushed by influences ever at work, must not be permitted to creep in under the guise of "naval reorganization."

The difficulties that beset the subject would be removed if the commission could sit on board ship, where the truth, the whole truth, and nothing but the truth would be easily obtainable—where the wheat could be separated from the chaff. The fallacy of many theories that savor of the shore would be plainly seen. Deceptive arguments, misleading statements, and absurd claims would be pitilessly exposed. It is from the deck of the ship that the problem should be considered, for it is plain that the ship is the unit of naval power and the true basis of naval efficiency. An organization that secures efficient ships will secure an efficient navy. If the ship is forgotten in formulating measures of reorganization, more harm than good may result from the consideration of the subject. It is to be hoped, therefore, that in the rush of individuals and classes for recognition during the cry for naval reorganization, the ship, the men, and the methods necessary to insure fighting efficiency may be kept ever in mind.

A brother officer to whom the remark was made that "it is very unfortunate for the Navy that questions relating to the personnel cannot be discussed and settled upon the true basis of ship efficiency just as we discuss questions relating to material, speed, and armament," replied that it was "simply because when

we deal with the personnel we trespass upon certain so-called 'vested rights.'" This is the whole thing in a nutshell: "vested rights" of a more or less personal nature form the principal obstacle to the proper organization of the Navy—an organization that would best meet the demands of a state of war.

But, plainly, if this principle of "vested rights" is to be recognized without limitation and for all time; if considerations of good fellowship are to rule inexorably; if men, material, and methods no longer useful are to remain forever; if the voice from the ship in commission—from those who take note and see clearly where the evils lie—is not to be heard; in short, if the truth regarding the unit of a navy's strength—the ship—is not to be known, there will be in the end, even after naval reorganization so-called is effected, far greater need for Naval Service Reform than there has ever been for Civil Service Reform in this country.

It is, therefore, with all due respect for "vested rights" and with courteous regard for the personal feelings of individuals, that it is proposed in this paper to handle the question of naval reorganization on the basis of what is deemed best for the ship. It is proposed to discuss the people on board ship, their duties there, and their relation to ship efficiency. In no other way can the substance of the matter be reached.

Promotion of Officers.

Three systems of promotion have been proposed as substitutes for that now in operation, all designed to bring officers to command and flag-rank at a reasonable age:

1. Promotion by selection.
2. Age retirement in grades.
3. Retirement by selection.

Each of these systems has its advocates, and each has its advantages and its defects. It is not deemed necessary to discuss these systems at length in this essay, for the simple reason that this subject is certain to receive its fair share of attention. Officers are on the ground ever ready to work in this field of discussion. There are other important matters that are likely to be forgotten, and it is to these that the writer wishes to devote particular attention. It is to be hoped, however, that whatever the system of promotion may be, it may not have the tendency to bring

political, personal, and social influences to the front in a manner that will be harmful and demoralizing to the Navy. It is possible, to be sure, that some individuals are too pessimistic and unnecessarily panic-stricken in this respect. It may be that their fears are groundless, or greatly exaggerated, regarding the possible influence of the *salon* in Washington, and that the tendency to resort to the Mme. de Staël system of influencing naval legislation and preferment at the national capital might not become so prevalent as they claim it would. But, nevertheless, it would be unwise to create among naval officers the impression that unless they get to Washington, or manage in some way to work up a "pull," their chances of advancement may be lessened. It is important that a system should be decided upon that will encourage officers to devote themselves zealously to their profession and to the performance of their duties in order to win reputations that will entitle them to promotion.

In connection with this question of "influence," the writer has heard the theory advanced of late, in all seriousness, that, whereas an officer in the junior grades who exhibits ability, zeal, and subordination, or who attaches himself to the fortunes of some officer of high rank, may get desirable duty, increase his professional knowledge, and gratify his ambition, he must depend upon something else when he reaches command and flag rank. That in the upper grades where he is no longer sought after by seniors who wish to utilize his intelligence, he must depend upon "influence," very often, to secure a desirable command—that such a detail may go to the officer of inferior talents and a superior "pull." In self-defense, therefore, it was argued, an officer must devote himself sooner or later to the cultivation of "influence."

This is a very delicate subject, but it cannot be altogether avoided in considering naval reorganization. Such a theory as the above, if advanced openly, as it has been, must be openly condemned and guarded against. In the attempt to increase the efficiency of the Navy, such matters must be handled without gloves. The principle must be laid down, that conspicuous professional services and ability in connection with ships and men—not "influence" or "pull," not services in society—shall secure promotion and reward for a naval officer.

In avoiding one danger, however, we must not run headlong into another. It may be possible to avoid the baneful effects of

"influence" without adopting a system that places a premium upon mediocrity, and that takes no account of ability or personal fitness. Such is the system that makes age or youth the sole criterion of advancement—a system that exists in no civil profession. Ability, physical and mental activity, should have some weight, and years alone do not determine this. One man at forty-five years of age may be far more active and zealous than another at thirty-five. Men differ from horses and wagons in the matter of wear and tear, because brains and personal habits enter with men to determine their usefulness after a lapse of years.

"Command rank young" is a thing to be desired, but it is not by any means a panacea to be secured at all costs. To be sure, any man will be benefited by reaching command rank at a reasonable age. But command from the cradle to the grave would result in conspicuous failure with some men, while others who attain command late in life will be conspicuously successful. After all, it is the man himself that settles the matter. The brain and practical ability, not years nor "influence," should determine the advancement of a man in any profession—even in the Navy. There must be some competition, some reward for energy and worth, some tendency to spur up the laggards. All men are *not* equal.

Officers Afloat.

Naval reorganization, as it affects officers, should surely be based upon an examination of the ship and its fighting efficiency. The question of promotion is very important, tending, as it may, to infuse spirit and energy into the service. But there is another important matter bearing upon the chances of a ship in battle—the number and kind of officers on board. Shall "vested rights" forbid an examination of this subject before our ships are called upon to face an enemy?

The statement has been made that there are too many line officers on board our ships. This statement has sometimes proceeded from a careless consideration of the subject, sometimes from ignorance, and again from malice. It is a very serious matter and should not be passed over lightly. A careful examination of the conditions existing in modern ships will prove that there are not too many line officers, and that in some instances there are too

few. Guns are now so scattered and separated from each other by bulkheads and turrets that more officers are needed to control a ship's battery than in former days. Means of communication are very incomplete, and parts of a ship's battery are entirely cut off from the control or view of the captain, executive, and divisional officers. The casualties likely to arise in these days of rapid-firing guns must not be forgotten in determining the number of officers needed to manage the armament. The result of an engagement might hang upon the presence of an officer at a certain gun or torpedo. It is very remarkable that in these days when it is admitted that the gun is the key to the situation, there should be an attempt to reduce the number of line officers. Such a scheme would certainly play into the hands of an enemy. In time of war the number of ships will be largely increased, and there will be too few line officers of the regular navy available to control the batteries afloat and to drill a horde of recruits into proper shape in a short time. That any man wearing the uniform of a naval officer should propose such a plan is amazing, to say the least.

It can be shown that even now, on a peace footing, there are not enough line officers on board some of our ships. It often happens that the powder and torpedo divisions are inadequately supplied with officers, owing to the fact that the whole length of the ship is included in these commands, and one or two officers cannot control the whole. The supply of ammunition is of vital importance, and the heterogeneous character of the powder division requires the presence of enough officers to secure confidence in every compartment.

When we stop to consider a ship in battle, it is plain that there should be as few officers as possible on board whose duties are restricted within narrow limits or confined to matters that do not materially affect the result of the fight. The perfect system would require that every officer on board should be available for any service in connection with the offensive power of the ship. This system should be approached, at least, if it cannot be fully realized.

If the paymaster and his clerk were line officers, there would be a gain of two officers available for duty in the powder, torpedo, or gun divisions. It is perfectly plain that a lieutenant and an ensign could easily perform the duties of a paymaster and his

clerk respectively. Their education, their knowledge of naval material, their contact with the men, and their general observation of the needs of the service would give them many advantages over paymasters. The latter are appointed from civil life, and have in the beginning no knowledge of the Navy, no acquaintance with naval material or methods, and little opportunity to acquire a sufficient knowledge to render them available for general service afloat. Here again we come to the question of "vested rights"; but we also find ourselves face to face with fighting efficiency, and we must decide which is to be ignored. There are no difficulties whatever that need prevent the assignment of line officers to the duties of paymasters, and nobody can deny that the efficiency of a ship for battle would be increased thereby. The idea that several young men should be annually discharged after a six years' course at the Naval Academy, while young men from civil life, with no naval training whatever, are admitted into the Navy as full-fledged commissioned officers, is an absurdity that may well be pointed out in an era of naval reorganization. Education and training are thrown away, technical and professional knowledge is discounted, and availability for naval service is ignored! In the place of young men who possess these qualifications, we take others who lack them all!

As regards engineer officers on board ship, it would be better if they were reduced in number and assigned solely to the duty of superintending the machinery. It has been suggested to consolidate the construction and engineer corps, forming one corps devoted to the work of designing ships and machinery, and supervising engines on board ship. Spending a portion of their time in service afloat, these officers would get the practical experience so necessary in the design of ships of war.

The active and purely mechanical duties of running the engines could be done by machinists and warrant officers, which arrangement would give deserved promotion to men in the engine-room. Such a plan would assign the commissioned engineers to congenial duty, and leave the work that requires no scientific training to the class of men who do such work in the merchant service and in civil life. The recent order of the Navy Department giving chief machinists engine-room watch is in line with this argument and merits approval.

It is only fair to point out that engineers and machinists can be more easily recruited in time of war than can line officers. The latter are not found in the civil pursuits, and officers of the merchant marine are no longer available, because of their complete ignorance of modern weapons, tactics, and naval strategy. In civil life, however, there are thousands of men engaged in the design and operation of machinery who would be perfectly available for service in the Navy in time of war. And in these days of armor and protective decks, the casualties in battle among engineer officers will be very few. Modern guns with their flat trajectories will seldom penetrate far below the water-line. From the accounts of the war in China, it would appear that the motive machinery of ships, and those handling it, were seldom disabled. It simply demonstrates that a surplus of engineer officers in time of peace is not necessary to provide for a state of war nor to fill vacancies in battle.

The few duties now performed by marine officers afloat could be assigned to line officers, who would also be available for all other naval work. Line officers belong to the "military branch" of the service, and must be competent to perform all military duties. They have a military training, and surely must be competent to do work formerly done by marine officers who entered from civil life, often with no military experience or training whatever.

When naval forces are landed for service on shore a line officer is usually in command, especially if the force is large and the duty correspondingly important. If line officers are competent to assume command of a *large* force in time of active service when weapons are used and men handled under fire (and this duty may fall to them at any time), they must surely be competent to take charge of a *small* force like a marine guard for like service; and still more reasonably must they be competent to control their men on board ship where there is no unusual emergency. Officers in a military service are supposed to seek duty in case of actual hostilities, or in case of threatened trouble afloat or ashore, and line officers are not exceptions to this rule. And as this service with men under arms, as infantry and artillery, has always been, and must always be, required of naval officers, they should be prepared for it—they certainly cannot afford to admit their incompetency nor their unwillingness to assume such responsi-

bilities. If the military duties and the supervision of the "guard" are left to the line officers afloat, they will be the better prepared for the duties that the service often demands of them. To claim their inability or unwillingness to do such work on board ship, and require them to do it on shore, where ignorance or lack of interest may be fatal, is a manifest absurdity.

The marine officer afloat is another case of "vested rights" that interferes with general naval efficiency, because a line officer in his place would certainly be more generally useful. The line officer must be willing to manage the military part of the Navy. He cannot gracefully admit his helplessness or his need of assistance in this branch of his profession. It is a fact that infantry drill and the guard duties in the Navy require less ability and less study than a hundred other duties that fall to a naval officer. A simple drill-book and a simple guard manual are needed—that is all. Unnecessary complexity in these matters has been a great bugbear.

It is unfortunate that some officers are inclined to deny the importance of landing forces. When we consider how frequently our men have been called upon to land in all parts of the world, it would be reasonable to say that a naval officer is quite as apt to be called upon for active service with men under arms on shore as with the ship's battery at sea. It follows that officers must prepare themselves for this important practical work, and must not glory in the fact that they know or care nothing about it.

It has been demonstrated repeatedly that naval officers are fully competent to command companies and battalions on shore, and to direct operations with signal ability. In the recent landing drills of the North Atlantic Squadron, line officers who had never before had an opportunity to witness or practice the new "extended order" grasped the subject at once and handled the bluejacket battalions in a manner that showed a peculiarly intelligent conception of all the practical points involved. The onlooker could not fail to see that the line officer is equal to all military duties, and that the infantry part brings the least strain upon his intellect. Two kinds of military officers are not needed afloat. The marine officer has no *raison d'être.* Officers of *general usefulness* are needed on board ship.

As far as it affects officers, naval reorganization is a very simple matter if the efficiency of the ship is the object sought. There are

too many corps and conflicting interests—a complexity and lack of homogeneity that interferes seriously with man-of-war efficiency. If reorganization is to be of any material benefit there must be a thorough examination of such matters. The main lines of reform have been marked out—proper promotion for those who are mainly responsible for the management of ships and squadrons in battle; the abolition of at least two corps afloat, and the substitution therefor of line officers who are available for all naval duty; the consolidation of the engineer and construction corps, and the assignment of officers and petty officers to the work for which they are best fitted.

Such a plan, which simply goes to the root of the matter, need not interfere with the "vested rights" of officers now in the service, if such rights are deemed of such importance that nothing whatever can be done to disturb them. All officers now on the list may be permitted to remain, and their pay, promotion, and duties may be unchanged—simply stop making any more appointments at the foot of the list and let line officers gradually fall into the places afloat. The result will ultimately be that there will remain only three distinct corps on board ship—the military, the medical, and the mechanical and construction corps.

In discussing naval reorganization it must not be forgotten that it is the duty of the line officer to command and control the whole ship—not simply a part of it. He is not restricted to one department. He may not be acquainted with all the trifling technical details of each department, and it is not necessary that he should be. But there must be some head, some governing mind, to maintain the balance between diverse individual interests and to direct all toward one end—efficiency for war. If the captain of a ship is to have complete command in battle, he must have complete command in time of peace. If he, more than anybody else, is responsible for the result of the fight, he must have more to say than anybody else regarding the system of organization before the battle begins. He is certainly interested in the efficiency of all departments. The whole trend of his duty and training fits him to adjust all the forces that unite to make a ship ready for action. Is there any other officer or individual who is better qualified for this work? Is it better that it should be left to a half-dozen different officers, each of whom controls

only a part of the organization, whose training is limited to a part, and who is inclined to acknowledge no all-controlling power? A general commanding an army properly decides, if anybody can, how much infantry, cavalry, and artillery are needed to conduct a campaign. The captain of a ship, and the officers who are educated for the ultimate purpose of command, must study naval organization in its broadest sense; and their competency to decide upon the general features, functions, and relations of all departments in order that all may be formed into an efficient and harmonious whole cannot be denied. It is for this duty that a line officer exists. If he neglects it, or is not permitted to consider it, who shall take it in hand? Who is more competent, who is more logically the proper man for the work? It is impossible to dodge the inevitable fact that it is the legitimate duty of line officers to exercise general control over the whole subject of naval organization in all departments; they are not meddling when they assume this function; they are not usurping power nor trespassing upon the "vested rights" of others—they are simply performing a "vested" duty, and the one which is most vital to an efficient navy. If each corps of the Navy is made independent and permitted to reorganize itself; if questions of rank, titles, and pay are to be decided exactly as the several corps may demand; and if certain matters which are of comparatively trivial importance in their bearing upon naval efficiency are to monopolize the attention of Congress, naval reorganization will be a dismal failure. The ship, and the true means of making it ready for battle, must be kept in mind; and it should be the duty of all who have the interests of the service at heart to demolish harmful and selfish schemes and fix the attention of Congress upon the problem of securing the officers, the men, and the methods that will most surely contribute to victory when the drum next beats to quarters for the honor of the flag at sea. In the grand charge of individuals and classes upon Congress to secure legislation, let somebody remember the motto, "Don't give up the ship."

Training of Officers.

No radical changes are necessary in the present system of training officers. The course of instruction at the Naval Academy has been developed with an intelligent conception of the needs of

the service and with due regard to the march of improvement in naval science. Many criticisms aimed at the school are hastily considered, and often proceed from erroneous ideas as to existing conditions. In some cases the changes suggested by well-meaning critics would result in a vast deal more harm than good.

The proposal to fix the age of admission at between fifteen and seventeen years, to extend the academic course to five years, and then to graduate the cadets as ensigns is a good one. In other respects the present curriculum and the general scheme of instruction are excellent, and can with difficulty be improved upon.

There are many objections to the present plan of sending the cadets to sea for two years before final graduation. One objection, not often noted, is that cadets necessarily feel that they must keep up the academic studies in order to prepare for the final examination; and as this examination is in no respect in advance of the one passed at the end of the four-year course, the cadet gains little in preparing for it. His attention is often drawn from the practical duties on board ship, and from careful observation of important professional work, to be concentrated upon books and theoretical studies. He sometimes asks to be excused from watch in order that he may get time to study, on the plea that some of his classmates who are permitted to devote their time to their books may gain an advantage thereby and pass him on the examination. This competition does not yield good results for this reason. It will be better if the graduate goes on board ship feeling that his status is assured, or that it may be improved by devoting himself exclusively to active professional duties rather than to books.

The vital importance of the Naval War College is now admitted. The institution has at last been given its proper place after many narrow escapes from determined enemies, whose reasons for attempting to kill it are beyond comprehension. The unanimous verdict of the officers who have received the benefits of the course, and who have noted its relation to naval efficiency, is sufficient proof of its value. It directs the minds of officers toward the methods of using naval material most effectively for purposes of war. Officers have devoted much time to the invention and manufacture of guns, and to the design and building of ships. To study how guns and ships should be directed against

an enemy is the most vitally practical part of a naval officer's training, and it is to this subject that the Naval War College is devoted.

In this connection it should be noted that there is at present no system by which officers may become well acquainted with the coast of the United States. It is perfectly possible for an officer to complete his career in the Navy, passing from cadet to admiral, spending nearly all his time on foreign stations, visiting comparatively few home ports, and thus getting a very imperfect idea of the coast of his own country. This is a serious defect in the training of officers. It is of the first importance that they should have a complete knowledge of the strategic features of our coast, and be perfectly familiar with the navigation of the inland waters and harbors. An intimate acquaintance with these matters is essential to the proper defense of the coast against an enemy. Such an important subject should not be left to chance. Naval routine in time of peace can easily provide proper instruction for all officers in this respect.

And there is now no systematic instruction of officers in piloting and conning ships. The many practical and valuable rules known to officers who have given particular attention to this subject, and who have had experience in coasting and piloting, should be known to all. An officer must not be left to pick up such things in a hap-hazard manner. He may any day be called upon at short notice, and with no previous experience whatever, to handle and pilot a ship under circumstances demanding perfect self-confidence and readiness of resource. He may in time of war be assigned to a part of the coast which he has never visited and of which he knows nothing. In such a case he cannot act with good effect against an enemy.

To provide for the instruction of officers in this particular, a ship of light draft should be assigned exclusively to this work. It should cruise for six months each year between Maine and Texas, three summer months on the northern coast and three winter months on the southern coast, and should be accompanied by a squadron of torpedo-boats with which to penetrate all inlets and inland passages. Every officer in the Navy should be sent to this ship at some time during his early career. The instruction should be strictly confined to the practical subjects of piloting and naval strategy, as developed by a careful examination of the

coast, and from data furnished by the Intelligence Office and War College. The President of the War College should have the general direction of this cruise, during and after which the discussion of problems of coast defense and attack should be encouraged, and the regular course should be completed by instruction at the War College as at present. Officers should in turn be permitted to pilot the ship, and all recognized precautions and wrinkles used in piloting should be systematically taught.

There can be no question that officers would take great interest in such work, and a year devoted to it would be well spent. The result would surely be felt in time of war—officers would display more dash, and exhibit a better knowledge of the means of harassing an enemy. Ships and torpedo-boats will be used with better effect if officers are given the advantage of such experience. This extension of the course of instruction would increase the objections to admitting foreign naval officers to the Naval War College.

Warrant Officers.

The warrant officers are entitled to consideration in the reorganization of the Navy. Standing between the grades of commissioned and petty officers, their relations to both are intimate and their duties are important. It is fortunate for the service that the Navy Department decided not to abolish boatswains, but to assign them to large ships where they are much needed. The boatswain came near being the first victim of the pernicious theory that seamanship is a lost art. It may be natural that those who are quite ignorant of the demands of man-of-war routine should fail to appreciate the fact that the sail is the shadow rather than the substance of seamanship. The Navy is suffering too much from such theories.

In the event of war the warrant officers would necessarily play an important part. Their thorough acquaintance with naval material and weapons, their intimate knowledge of the men, and their experience in controlling them would make the warrant officers the most valuable of all the men who would be available to recruit the lower grades of commissioned officers. Their efficiency in such positions would surely be greater than that of men of a higher social and intellectual standard who lack the

practical knowledge, who have served but little afloat, or who have been out of the Navy for a considerable period. The line of the Navy cannot be so well recruited from the beach as from the ship, from landsmen as from seamen, and it is high time that this fact should be recognized.

It is more than likely, therefore, that with the great expansion of our navy which a state of war would entail, the warrant officers, and perhaps some petty officers, of the regular navy would receive commissions in the volunteer service, and that many of these men would return to their previous duties at the close of the war, just as hundreds who were officers of high rank in the volunteer army during the civil war returned to the subordinate grades when hostilities ceased.

And there is another all-sufficient reason why a proper interest should be taken in the warrant officers. It is to this grade that the enlisted men of the Navy must look for their main hope of promotion. It is recognized nowadays that a line officer of the Navy requires an academic or college education. It is not necessary to argue this point. Such a fact does not make the Navy an aristocracy any more than the fact that a man must study law before he can be admitted to the bar makes lawyers aristocrats. There are certain callings that require a thorough education, and the Navy is one of them. The Naval Academy is a thoroughly democratic institution. It might be well to provide that all candidates should be chosen by competitive examination in order to eliminate personal and political influence. But to lower the standard of the school, or the standard of a naval officer's training, would be an injury to the service that is not justifiable on any ground whatever.

The Army and Navy differ in some respects, and it is submitted that it is more practicable for a man to rise from the ranks to a commission in the Army than in the Navy. In the latter case, the environment is not conducive to study; the opportunities, the leisure, and the facilities for self-education on board ship are by no means so good as they are on land. And the numerous duties of a more or less scientific and diplomatic nature that fall to the lot of a naval officer demand that he shall be very carefully trained.

It is well enough to recognize the right of an enlisted man to a commission, and in this respect the Meyer Bill should become

a law. Any man who can attain the required standard by reason of early training and by dint of study and observation should certainly be given a commission. Under proper conditions this plan would result in good to the service and in the elevation of the man-of-war's man's calling. But while the Naval Academy exists it must furnish the mass of our line officers. Only a few enlisted men could reasonably expect to secure commissions, except during a great expansion of the service in case of sudden war. It is not wise, therefore, to hold out illusive hopes to the men. And as a rule it will be found that they have a thoroughly sensible idea of the matter themselves and do not base their claims to advancement upon false theories.

If it is admitted that warrant rank must be the main hope of the enlisted men, there should evidently be as many warrant officers in the service as practicable, in order that the chance of promotion for men may be as encouraging as possible. We should employ warrant officers wherever the efficiency of the service will be conserved.

It has been proposed to increase the gunners by the addition of a number who are to be specially trained in all matters pertaining to turret guns, turret machinery, torpedoes, and the electrical devices connected with the battery. Such a plan is wise. There should be not less than two such gunners on board a first-class battle-ship available for the all-around subordinate duties with the battery.

The proposition has also been made to give warrant rank to the men in the engine-room. This would be a reasonable concession, to say the least. It is hardly right that the grade of machinist should be the highest to which a man in the engine-room can ever attain. Warrant rank there would be a great encouragement, and would undoubtedly result in greatly improving the morale and efficiency of the engineer department. The recent order giving chief machinists an engine-room watch is a step in this direction, and it would only be a just recognition of practical ability to give warrant rank to machinists who can take charge of a watch. There are in the Navy many small craft—little coast-survey steamers and others with simple machinery—which could be managed by a warrant engineer quite as well as the thousands of tugs and steamers in our harbors and along the coast. Such a plan gives promotion where it is needed.

A commissioned engineer is not needed on board these little steamers. The assignment of commissioned engineers to scientific work leaves the field open for the practical mechanical engineer who takes charge of machinery the world over in the merchant marine. But if we are to have a full complement of commissioned engineers to stand the watches, there is evidently no chance for the practical man to attain warrant rank. Two bodies cannot occupy the same space at the same time.

There will be plenty of room for the necessary number of warrant officers on board ship when the reforms suggested in the first part of this paper are made—when practical considerations govern the assignment of commissioned officers to a fighting ship. When cadets are graduated as ensigns there need be but one commissioned officers' mess on board ship, and space will be available for warrant officers' quarters and mess-room.

It is in this direction that means may be found to give enlisted men ample reward and promotion afloat. It is here that certain "rights" of enlisted men should be "vested"—far more justly vested, and with far greater benefit to the Navy than many other "rights," which, when subjected to the light of reason thrown upon them from within the ship, are seen to rest upon principles that are inevitably injurious to the service. We have come back to the ship as the basis of organization, promotion, and reward. It will be well to stay there and continue the investigation of the subject from the deck and from below. It is from this point of view that we can best see the officers and men, note what they are doing or not doing, determine the justice of their "vested rights," and decide whether they may be changed with the effect to improve the ship as a fighting machine—the object sought in naval reorganization.

Rewards for Enlisted Men.

The brief reference to the question of promotion for enlisted men leads to the consideration of other means of rewarding those who serve faithfully and continuously on board ship. The action of the Navy Department in giving certain positions on board receiving ships and at shore stations to men of twenty years service, and the provision of the Joint Commission Bill giving such men appointments as watchmen at navy-yards, are excellent as far as they go.

There has been a suggestion, in no sense original with the writer, to extend this principle with every prospect of great good to the service ashore and afloat, and in a manner that would greatly encourage men to remain for a term of years in active service on board ship. It will be found upon examination that there are many positions that carry good pay and steady, agreeable employment in the navy-yards, which are now filled by political or other appointments from men in civil life. It is the complaint quite frequently by officers on duty, that many of these men are so unfamiliar with naval methods and material that they are quite inefficient in routine work. They are coming and going, take little real interest in the work as it bears upon the Navy, and contribute nothing to its well-being. The application of civil service rules would improve matters somewhat, to be sure; but why should not naval service rules operate in a navy-yard? Why should not desirable positions *within the naval establishment* be given to those who have justly earned consideration and promotion by zealous and faithful service afloat, instead of giving such places to men who have never served the flag in any capacity whatever? There will be found on board ship, in the various departments and grades, men who are competent to fill many of the most important and desirable positions in the navy-yards. These men, familiar with ships and everything pertaining to them, would be particularly efficient, and would do the work required with peculiar intelligence. They would form a link between the establishments ashore and afloat, and would be available for a reserve in time of war—*a very valuable reserve indeed.* A certain length of service afloat should be required before a man becomes eligible for an appointment to shore duty, and the service should be continuous and entitle him to retirement after thirty-five or forty years' service. When so many naval officers are employed on shore more than half of their lives, and are retired after less than ten years' sea service in some cases, there is no reason why the same privilege should not be granted to the men.

The writer takes no credit for this suggestion, but adopts it bodily from others. And it would be well for the Navy if suggestions "from others" were adopted more frequently, with all due regard for the precautions necessary to avoid hasty action. This particular proposition is sound, and merits the attention of

those whose duty it is to consider the means of encouraging the enlisted men of the Navy. When one faces this matter squarely, and with a proper regard for truth, it will be seen that there are within the limits of the naval establishment so many lost opportunities for improving the condition of our men as to justify the assertion that this subject has been neglected and thrown into the shade while a hundred other matters of vastly less importance —except for the harm involved—have occupied the minds of those to whom alone the men can look with hope. We need Naval Service Reform for those who deserve all the rewards that the Navy affords. It is a bad system which gives the biggest plum to the man who makes the least sacrifice and does the least work. *The Navy should at least take care of its own.* Naval officers should not be so occupied with the routine and with material that men are forgotten.

Petty Officers of the Navy.

It has been admitted for years past that the status of our petty officers is not what it should be on board ship. The recent regulations by which permanency of appointment is secured, will undoubtedly tend to improve the petty officers and make their positions more desirable in their eyes. The regulation is an excellent one, notwithstanding the criticisms aimed at it. It may be possible to change it somewhat, but the element of permanency in rating should be preserved.

While there has been an improvement in some respects, the status of the petty officer—his place as a military factor in drill and discipline—remains practically the same as before. He is still too much of a nonentity. His importance is not properly recognized, he is not properly developed, and his intelligence and abilities are not fully utilized. An occasional ship may adopt a system that puts petty officers somewhat to the fore. Individual officers may sometimes give them a chance. But the result of these sporadic efforts is lost in the "custom of the service." A few individuals cannot counteract the workings of a system of long duration and almost universal application. And, recognizing this fact after a time, officers are inclined to become discouraged; hopeless of accomplishing any good, they adopt the prevalent idea. It is plain that there must be a general and hearty recognition of the petty officer's importance, an intelligent con-

ception of his true relation to the naval establishment, and a united and systematic effort to develop him before any marked improvement in his status can be expected. As yet, this effort has not been made. Boatswains' mates are daily seen to do a landsman's work about the deck, and the whole genius of our system is to prevent their improvement.

It is universally recognized that the efficiency of an army depends largely upon its non-commissioned officers. They are given a wide range of authority, and are respected and obeyed as though they were commissioned officers. Of the German army it is said: "There are 100,000 non-commissioned officers who are soldiers by profession, enlisted for several successive terms, and who do not intend to return to civil life. *The government encourages this class*, for it is only by having a very well trained body of non-commissioned officers that recruits can be licked into shape rapidly as they are in the fatherland." This is the place to ask the question: Is not the petty officer as valuable to the navy as the non-commissioned officer is to the army, and should not his status and his relation to the organization be the same in all respects?

Consider the petty officer in battle. His divisional officer may be disabled, leaving him in charge of a gun division. The big guns in a battle-ship's turret may be left in his charge. The battery is so divided by bulkheads and turrets, and so shut off from the view of the captain and executive, that a petty officer may be left quite to his own resources. The result of a sea fight may largely rest upon him. The direction of a torpedo, or a crushing shot in an emergency, may depend solely upon his judgment. With poor means of communication with his commanding officer, with the many peculiarly trying conditions that obtain in a sea fight, a higher degree of nerve, intelligence, and ability to command others may be required of a petty officer than will ever be demanded of a non-commissioned officer on shore. If there is necessity for developing and teaching the sergeant to command, there is still more necessity for doing the same with the petty officer. It is remarkable indeed that there are people who will preach the absolute necessity of giving a commissioned officer responsibility, in order to fit him to command, who cannot recognize that the same rule applies to the petty officer as well. He is human. He, too, must be trusted if he is ever to be

trustworthy. He, as well as the officer, must be permitted to command somebody in time of peace, if he is expected to command anybody in time of war. He must be relied upon, if he is to be self-reliant. To acquire the habit of command, he must have some practice.

There are instances of petty officers who are graduates of the apprentice, gunnery, and torpedo schools—men of intelligence who know all about ships and weapons, who are invaluable by reason of their intimate acquaintance with naval material—who have never even been permitted to control, drill, discipline, or instruct a squad of men in time of peace! They are trusted less in some cases than a recruit who comes on board from the marine barracks and who may be totally ignorant of ships and everything on board. Is this the proper way to train men for war? Is this the way to bring up a "well-trained body" of petty officers by whom "recruits can be licked into shape rapidly"? Is this the way our government should "encourage this class"? We shall have many recruits in time of war. The expansion of our navy would emphasize still more the importance of the petty officer. He would become still more a "leading man." The fact is, our petty officers should be developed far beyond those of any other navy, because, with scant material and many recruits, we may be called upon to meet an enemy whose navy is always on a war footing. In the complete, the utmost possible development of our petty officers, is a safeguard that no practical naval officer should fail to recognize. But this fact has not been recognized by any means. On the contrary, the opposite policy of keeping the petty officer down has been too often practiced. Quite recently an executive officer said to a naval cadet who had the temerity to place some responsibility upon a petty officer: "Haven't you learned yet, sir, never to trust a bluejacket?"

In service on shore, in the streets of cities and elsewhere, it is very possible that a company of bluejackets may be divided into squads and posted at different points. The company officers may not be able to control or direct the men at all times. They cannot be everywhere, and they may be disabled, leaving the petty officer in command. Surely the latter should be trained for such an emergency. It may be necessary for him to command his men to fire, and yet it is safe to say that not one-tenth of the petty officers of the United States Navy have ever given a

command to a squad to fire even a blank cartridge! And as for firing ball cartridge, the writer has never known, and never heard, of a single case where a petty officer has been permitted to command a squad to fire volleys at a target—in fact, very few commissioned officers have ever done such a thing!

Furthermore, in service on shore, guard duty has often been required of bluejackets. and petty officers under circumstances of peculiar gravity, and such may be the case at any time. Does the routine of the Navy, does our system of discipline and training on board ship, prepare the petty officer for this duty which he may be required at short notice to perform in the face of an enemy on shore? Not at all. On the contrary, his training and duty afloat tend to unfit him for guard duty. He is taught nothing about it. He is not permitted to practice it. He is given no opportunity to learn it, and the theory has been established that he would be untrustworthy and inefficient as corporal of the guard! The non-commissioned officers of marines monopolize this duty, thus preventing the training and development of the petty officer. A small fraction of the ship's crew prevents the all-around education of the mass, just as the assignment to this duty of a few of the men at an army post would prevent the proper training of those who are deprived of, and considered unfit for, this work.

"In time of peace prepare for war." A petty officer is not prepared to direct the fire of a division in battle if he is not permitted to drill a squad in time of peace. He is not prepared to do guard duty on shore if he is considered unfit to do it on board ship. He is not prepared to "lick recruits into shape rapidly" when war comes if he cannot instruct recruits in time of peace. He is not prepared to direct the fire of a squad in the street of a city, or elsewhere, if he has never given the command to fire ball cartridge ashore or afloat. In short, when we consider the duties that must inevitably fall to a petty officer in time of war, or that he ought to do at such a time, it will be seen that he is not being properly prepared by the present system of training. A change is, therefore, imperatively necessary.

There is a simple solution of this petty officer problem, and only one solution—give him *unreservedly* the exact position and status that is accorded the non-commissioned officers in an army. There must be no half-way action. Let it be plainly seen that

"the government encourages this class." Let recognition of their worth come from their seniors. They will prove worthy of the trust. Their development will be assured, the men will respect them, and discipline on board ship with such a force of petty officers distributed through all compartments will be vastly improved.

Naval officers should permit no obstacle to check or prevent the improvement of the petty officer. They should turn from books, material, official papers, and routine duties long enough to attend to this matter. Foreign systems should be studied and all good points noted. But we must first know our own people, study our own needs, note the conditions that war would thrust upon this country, and prepare our men for the emergency with an intelligent regard for their personal and national traits. Originality may be necessary in the treatment of the subject. Manhood must surely be recognized more fully in our navy than in any other navy in the world if we are to be properly prepared for war. The petty officers must be prepared for higher duties, and the men must be prepared to be petty officers in the volunteer navy. A high standard is imperative.

THE BLUEJACKET.

There has been a greater improvement in the bluejacket during recent years than is commonly supposed. The report of the Chief of the Bureau of Navigation states that seventy per cent. of the enlisted men are citizens of the United States. That there are fewer bad characters among the men than formerly is very apparent. Serious offenses against discipline are comparatively rare, and it may be said that the tendency toward mutiny or insubordination no longer exists—it would certainly be condemned by the men themselves.

Among the recruits nowadays many excellent men are found—men who are amenable to a high state of discipline, and who would be glad to remain in the service for a considerable term of years if assured a fair chance of advancement to positions within the naval establishment afloat and ashore to which long service entitles them, and which, as demonstrated elsewhere, could be given to general-service men with great good to the Navy.

It is unfortunate that owing to the lack of men it has been necessary to send many apprentices to sea-going ships before

they are properly developed physically or professionally. The effect has been bad in many ways. The burden of ship work and other conditions forced upon them have been very trying, because the working force afloat is small in proportion to the drudgery. Disgust and discouragement drive many ashore, and those who remain, under the system of discipline now in vogue, do not reach the high state of efficiency to which such excellent material could easily be brought. They would make better petty officers if they were accustomed to see petty officers put to the front. They would be more trustworthy if from the moment they go on board ship they found that the bluejacket is *expected to be trustworthy*. They reach the level established for them by naval custom. They could rise far higher if permitted or required to do so. The material is splendid, but the work of seasoning, polishing, and finishing it is half done. Where mediocrity and carelessness are *expected* of men, excellence and thoughtfulness are *not bred*. The bluejacket of the Navy has been the unfortunate victim of theories that have stunted his growth and forbidden his elevation—"Never trust a bluejacket, sir!"

The man is the most important of all factors in a military establishment, and the more attention he receives the better, particularly during an era of "reorganization." Of the Emperor Napoleon, even while seated in the Tuileries, it is said, "His chief concern was for the equipment and well-being of his men—not only for their uniforms, accoutrements, and arms, but for their food, shelter, and pay."

It will be well for the Navy when the "chief concern" of the officers is for *their men*. It is the most important of all studies for an officer—the study of men and how to make them efficient. It outweighs in its practical and immediate bearing upon naval efficiency all other subjects to which he gives attention. He should devote himself to it as long as he is on the active list. And as long after he is placed upon the retired list as he retains possession of his faculties and feels an interest in the service, he should do all in his power to guard the interests and promote the welfare of the men upon whom he always depended when in a tight place.

In the Navy to-day the officers who are in direct contact with the men are between thirty-five and forty-five years of age, as a rule. They have drilled the men with old arms and new, under the

old regime and under the new, on board old ships and modern ships. They have had exceptional opportunities to study the men and to note the changes that have taken place in them, and the changes still needed to satisfy modern requirements. In this respect it may be said, with all due deference, that the opportunities of these officers for observation and intelligent criticism have been far better than in the case of officers of higher rank who have been further removed from the men under both the old and new regimes. And as that term of reproach, "youth," can hardly be applied now to the officers in question, they having reached the age when men in all professions are supposed to be in the full possession of their reasoning faculties, it is only fair to say that their judgment can be relied upon and that their opinions are worthy of respect. It might be said, in fact, that if the men are to be considered at all in reorganizing the Navy, the officers—no longer "young men"—who are drilling these men with all kinds of weapons, who are daily and hourly in contact with them, and who can best note their condition, their needs, and their feelings, should be encouraged to speak out and tell the truth and the whole truth about the matter. The truth will not be known otherwise—that is certain. There are probably sixty millions of people in this country who know practically nothing about the bluejacket. Few Congressmen have ever been on board a man-of-war. There are many officers who have never inspected the decks of a modern ship below when the men were in their hammocks; who have never noted the number of men engaged in coaling a ship; and who are totally oblivious of the many demoralizing and harmful conditions from which the men should be immediately freed.

The fact that there are so many people who are necessarily ignorant of the conditions existing or desirable regarding the men, makes it imperative that officers should inform themselves and others also. There should be no tendency to discourage officers from investigating this subject—they should not be forbidden to approach it, to discuss it, to speak plainly, courageously, and conscientiously about it. But there has been such a tendency in the past, and it still exists. The mention of the subject has often produced irritation, sometimes brought forth condemnation, and in some cases officers have hesitated to express what they knew to be the truth regarding the needs of the men,

because the subject has been tabooed or because they have feared the displeasure of their seniors.

The effect of such a tendency upon the younger officers will be mischievous in the extreme. They, in common with many older officers, give too much of their time and thought to routine work and to the study of scientific subjects. Nothing will work such injury to the Navy as to discourage officers from studying the question of men. Nothing will so surely promote efficiency as to require officers at all times to devote themselves to the problem of bringing our bluejackets to the highest practicable degree of development.

It would be well if the men on board a man-of-war could be considered as weapons. Officers are encouraged to discuss and write about weapons, to point out weaknesses, to recommend changes, and to suggest the replacing of one weapon by a more useful or effective one. Zeal in this direction is praised and rewarded. Officers make brilliant reputations in this way.

The man is, at least, a part of every weapon—the most vital part—which determines whether the weapon shall be effective or not. It is useless to develop all parts except this—the main spring. If a breech-plug is faulty, we reject it. A firing mechanism that can be improved upon is replaced by a better one. No effort is spared to attain absolute perfection in the parts of a weapon that do not think and that cannot act alone. The same rule should hold with men—the parts that *do* think and act. Those who can be replaced by others who are more efficient and more useful should be withdrawn at once. It is not a question of sickly sentiment nor personal convenience. It is a question of making weapons and ships most effective for war purposes.

The large majority of naval officers believe that the time has come to develop the petty officer and to trust the bluejacket—*this is all that is needed to bring them to the required standard.* The bluejacket is the proper type of man. There is no doubt of this. He knows enough, and it is only necessary to utilize his intelligence and bring out his manliness.

The pernicious theory that seamen are no longer needed in the Navy has been publicly proclaimed, with other ideas absolutely destructive of ship efficiency. It is unnecessary to stop to disprove such a statement. Officers who go to sea know that seamen are needed every day in a mastless battle-ship. To those

who claim the contrary, the laconic remark of an officer is applicable: "There is something sublime in a man who, off-hand, can decide momentous questions about which he knows nothing whatever."

No doubt many people are innocently led into error in this matter. They discard the sailor with the sail, and they want a soldier with a gun. They do not appreciate that the bluejacket is easily taught a soldier's drill, but that a soldier cannot be so easily taught the hundred things that a seaman must know. It is perfectly possible to take a company of seamen who have never drilled at infantry and teach them the present "manual of arms," "close order" and "extended order" drills in two weeks, so that they will do fairly well. In the ordinary routine of our ships, where opportunities are few and drawbacks many, our bluejackets are now taught to drill extremely well at infantry. They master the subject with perfect ease—it is only necessary to secure their attention. Even in the bayonet drill many of them are highly proficient, and all can be made so. With all due respect, it may be said that to learn the pantomimic motions of a manual of arms, and the Knights-Templar-like movements of infantry drill, does not require anything like the degree of intelligence and activity that are demanded of a seaman aloft. The assertion is ventured that there has never been a system of infantry tactics to master which required on the part of men so high a state of discipline, so high an average of personal intelligence, and such quick united action as was demanded of seamen in the spar and sail drills on board a well drilled ship. "Fours right" and "charge bayonets" bring less strain on a man, physically and mentally, than to pass an earring or furl a topgallant sail. The men who can do the latter can be taught the former—well enough for all practical purposes, and in a very short time. The possibility of teaching the bluejacket all that it is necessary for him to know about soldiering may be seen from a consideration of the following declarations of Admiral Colomb, R. N., regarding the English man-of-war's man: "What shall we say of the courage and loyalty of the present bluejacket? We may say there was never greater trial of it than was recently made in the Soudan, and it never had a more magnificent triumph. All the bluejackets' fighting of late *has been on shore*, and probably there are *no light troops in the world* such as those we land from our ships. Speed of move-

ment, steadiness, reliability, daring of the highest quality are all there, and *evolution in this respect has been toward perfection.* What, again, of his loyalty and discipline? There is in this respect *no difference now between the bluejacket and the marine.*" The italics are mine. This declaration is full of significance. It merits study. Just at this time, when the possibility of war with England is being discussed, the subject is peculiarly interesting.

Now what shall *we* say about *our* bluejackets? Are they now, or are they ever to be, equal to the English bluejackets as "light troops"? Can they not also be made to display "steadiness, reliability, and daring of the highest quality"? And "what again of *their* loyalty and discipline"? Are they, unlike the English bluejackets, inferior to the marines in this respect? If these questions must be answered in the negative, there is cause for humiliation. Line officers are responsible for the training of the men, and to clear themselves from the charge of incompetency or neglect they must be able to answer these questions in the affirmative. There is no alternative. The men of the Navy are, and always will be, just what the officers have made them—because officers are supposed to have the power to mould men at will. It is not sufficient to claim that the material has not been good. In this case means should have been taken to secure better material, and the means of doing so have been pointed out.

From this declaration of an English admiral, we turn to the following statement made by an American naval officer regarding a case where bluejackets were required to do guard and sentry duty: "The men behaved admirably in all respects save one; despite the Utopian theories of certain optimists who argue that marines may be dispensed with, it was found that the sentries and even the petty officers of the guard could not in many cases be relied upon to prevent the introduction of liquor, and this one subject was the cause of much annoyance, and necessitated the most unceasing vigilance on the part of the officers and the police authorities of the ship."

This statement carries with it the following deductions:

1. The presence of the marines on board ship for one hundred years, and the system of discipline practiced afloat, has not resulted in making bluejackets trustworthy.

2. The marine alone can be "relied upon to prevent the introduction of liquor," and if he is withdrawn from ships, or if he is not ever-present as a guard, "the most unceasing vigilance on the part of officers and police authorities" will always be necessary—it is "Utopian" and optimistic to expect a bluejacket to be reliable, and line officers cannot make him so! This it what the statement means, if it means anything. Now the question is: Shall a system of discipline that has resulted in a condition of things so deeply humiliating be perpetuated? Shall our method of training men continue to rest *upon the cardinal principle that bluejackets and petty officers are essentially untrustworthy?* Shall we view this pitiful spectacle with hopeless resignation, and declare in this era of naval reorganization that it is impossible or undesirable to teach a bluejacket to be reliable?

Rather than subscribe to this theory of certain pessimists, the writer would greatly prefer the "Utopian theory of certain optimists" who argue that the line officer of the Navy is quite competent to train petty officers and men to be reliable. In the latter theory the aim is certainly higher, there is less humiliation, and there is a better chance of naval efficiency. There are some admissions which a military man should blush to make, and one of them is that he is unequal to the task of training men to meet the demands of the service. And after trying one system for one hundred years and finding it a failure, he should try another. If an army officer can convert a raw recruit into a reliable sentry in a few weeks, it is not so very "Utopian" and optimistic for a naval officer to claim *that he can attain the same result in a few months!*

It is not difficult to account for the fact that some of the bluejackets and petty officers proved to be unreliable in the case cited. They had not been trained for this duty by the prevalent naval system that is reflected in the remark, "Never trust a bluejacket, sir!" If thirty ships in the Navy followed the plan of *not* trusting bluejackets, one ship may not succeed perfectly in pursuing the opposite course. And it is only fair to say in behalf of the bluejacket, that marines have not always been successful in preventing the smuggling of liquor. Rum has often been passed through a double line of marine sentries in a navy-yard. Marines have been known to do it themselves. Men have been known to leave a ship without permission repeatedly, pass two

cordons of marine sentries, scale a navy-yard wall, and return on board again without being caught, *even after the sentries had been told to look out for them!* Despite certain pessimists, there will be "no difference between the discipline of the bluejacket and the marine" when the former is trusted as much as the latter —*when the naval system of training demands trustworthiness.*

SHIP-WORK AND CONDITIONS AFLOAT.

It goes without saying that naval officers, to make men satisfied with the service and to make a ship as efficient as possible, must devote as much attention to the well-being of their men—to their "uniforms, food, shelter, and pay"—as did the Emperor Napoleon in the case of his men. There is plenty of evidence that these matters do not receive proper attention. The system of messing, for instance, is so bad, so wasteful and complicated, involving so many "caterers" and the loss of so much money, that essays might be written upon this one subject—and yet the system remains. The truth is that officers are not in the habit of analyzing closely enough all the matters affecting the men's comfort and their morale. And in the matter of ship-work there is a degree of indifference, or a failure to appreciate the necessity for decided reforms, that is truly astonishing. Nothing so seriously threatens the *esprit* of the men, nothing is so discouraging and demoralizing to them, as the neglect to reduce the number of idlers on board ship. The working force, as a rule, is ridiculously small in proportion to the size of the crew. In a recent instance, out of a complement of about 300 men, sixty-seven men—half of whom were young apprentices not fit to do a man's work—toiled for three days in a hot tropical sun passing 450 tons of coal on board. When the same ship was docked later on, forty-six men were counted scraping her bottom under trying circumstances. In both cases there were about thirty able-bodied marines on board ship, half of whom were standing sentry duty in four watches, while the other half were off duty for the day. And yet we are told that the *marines* are so overworked that *the limit of human endurance has been reached.*

To view this picture and not be impressed with the necessity for a change would be to ignore a matter the importance of which cannot be overestimated. In time of war such a state of

things could not be tolerated for an instant; why then should it be tolerated in time of peace? In neither of these cases were sentries needed. Petty officers could have been stationed and employed in a manner to prevent the possibility of an infraction of regulations, and all other enlisted men of the combatant class could have been put at work, thus increasing the working force fully thirty per cent.

Sentry duty would greatly improve and develop the bluejacket. He would be braced up by being permitted to act as an orderly, and the captain would thus have a splendid chance to influence the bearing, the manner, and the efficiency of his men. *He should be glad of such an opportunity.* That the effect would be elevating and beneficial cannot be denied, and it would improve the bluejacket in the only direction in which he lacks training and experience. An orderly who is familiar with ships, and acquainted with technical terms, would make fewer serious mistakes in carrying certain messages. In the matter of personal cleanliness there is much to be said in praise of the bluejacket. His work in cleaning ship and in scrubbing his clothes breeds the habit of keeping his person clean.

The present plan of mixing the bluejackets and marines causes overcrowding without a gain in working men, and will always deprive the bluejacket of the experience in guard duty. A detail of the latter should always be assigned to this duty when the ship-work does not require "all hands." When "all hands" are needed, *sentries are not needed*—petty officers can look out for discipline *at such times.*

If, instead of withdrawing marines from ships and replacing them by the same number of bluejackets for the reasons given, we are to withdraw a certain number of bluejackets from the battery and replace them by marines, the result will be to reduce the working force still more and thus aggravate the evils from which the service is now suffering. To say that the marine should replace the bluejacket because he may be as good a gunner as the latter is not so logical as to say that the bluejacket, having become as good a rifleman as the marine (as shown by the records of target practice), and being far more useful for general service, should be the one to survive.

Should it be decided in the future to withdraw marines from ships, and thus recognize beyond question that in "loyalty and

discipline there is no difference between the bluejacket and the marine," both corps could be brought to a higher state of efficiency than at present. There should be at least six permanently organized battalions of marines, two on the Pacific coast and four on the Atlantic—one at Boston and Portsmouth, a second at New York, a third at Philadelphia and Washington, and a fourth at Norfolk, Port Royal, and Pensacola. There should be a transport on each coast ready to transfer these battalions to any threatened point. There should be two permanent camping grounds on the coast, one in the vicinity of Gardner's Bay for use in summer, and one in the South for use in winter. The marine battalions could be transferred to these camps annually for special instruction and field manœuvres, and the ships of the North Atlantic Squadron could also visit these camps occasionally for the purpose of instructing their crews in such matters. The camp equipage could be stored at the most convenient naval station and transported to the camp when needed.

In this manner the marines would be available to co-operate with the Navy without preventing the all-around development of the bluejacket. That the latter would be immensely benefited by such a plan is beyond question. It is peculiarly in harmony with American institutions and character that the bluejacket and petty officer should be freed from the slightest suspicion of untrustworthiness and insubordination. Their equality with soldiers as far as "steadiness and reliability" are concerned should be recognized. No matter what may be the custom in foreign navies, this question should be considered from the standpoint of the greatest good to the greatest number, and with a view to bringing the whole Navy, not a part of it, up to the highest possible standard.

Men of education and intelligence have not hesitated to enlist and serve in the ranks of the Army in time of war. There is no reason why the same class should not be willing to serve in the ranks of the Navy, particularly if the standard of the bluejacket is raised as suggested in this paper. The seaman has a better bed than the soldier, and is surer of three good meals a day. He can certainly keep himself cleaner than the soldier, because there is plenty of water at sea, and the conditions of life may be more agreeable in many ways than in active service on land. It is to be hoped that the high standard of intelligence for which

the naval militia is distinguished may have the effect to ennoble the man-of-war's man's calling in the eyes of the people. The men of the militia seem to be proud of the blue shirt of the sailor, and their influence should be exerted toward securing for the bluejacket of the Navy full recognition for his manliness and respectability.

The following is a recapitulation of the methods advocated in this paper to secure the highest degree of fighting efficiency for our ships:

1. Make the organization as homogeneous as possible, both as regards officers and men.

2. Assign to the duties on board ships the commissioned officers who will plainly be most useful in battle; the same will inevitably be the most useful in time of peace.

3. Make warrant officers as numerous as possible, in order to provide promotion for enlisted men.

4. Give the petty officer the exact status of a non-commissioned officer in the army.

5. Trust the bluejackets, and give them the responsibility of sentry duty, that they may be the better fitted to become petty officers.

6. Bring every possible muscle in the ship to aid in bearing the burden of ship-work.

7. Seek a higher standard than in any other navy in the development of the enlisted men, because of the unusual strain that a state of war would bring upon our service.

8. Give continuous-service men desirable positions in navy-yards as an inducement for good men to remain for a term of years afloat.

9. Encourage officers to study the art of training and developing men, in order that the United States Navy may profit by the established principle that—"*Historically, good men with poor ships are better than poor men with good ships*; over and over again the French Revolution taught this lesson, which our own age with its rage for the last new thing in material improvement has largely dropped out of memory." [Mahan.]

In conclusion, the writer begs leave to state that there is nothing new in this paper except possibly the proposition to instruct officers systematically and carefully in piloting and in all the strategic features of the home coast. In other respects, conversa-

tion with officers of all grades leads to the belief that the recommendations in this paper voice the sentiments of a large majority of the line officers of the Navy—sentiments that are heard every day on board ship. If perfect freedom is permitted in discussing and advocating measures that are deemed *injurious* to the service, *the same freedom must be permitted in condemning them.* In no other way will evils be discovered until they have grown to enormous proportions. The chances of victory largely depend upon the number and kind of men who are assigned to a ship. If it is forbidden to suggest changes in time of peace, it may not be discovered until too late that defeat could have been averted by placing on board ship the officers and men who are logically best fitted to contribute to the fighting efficiency of a man-of-war.

An apology is hardly necessary in presenting this subject before an Institute that is supposed to encourage the discussion of matters affecting the efficiency of the Navy. It may be sufficient to say that this step is taken with all due respect for the feelings of individuals in the service, but with a firm conviction that a frank, fearless, and searching examination of the personnel afloat is necessary at a time when "naval reorganization" is being considered and when the possibility, at least, of future war may be admitted.

DISCUSSION.

Captain R. D. Evans, U. S. N.—Mr. Chairman: I find myself in accord with Lieutenant Fullam on "The Organization, Training, and Discipline of the Navy Personnel," as viewed from the ship, and I am sure all sea officers must thank him for his plain-spoken and timely words.

I believe that the proper organization of the line of the Navy will be found in increasing the numbers in the several grades to meet the demand that will be made upon them as the Navy is increased to the proportions it must, in the near future, assume. At the same time incompetent officers must be weeded out by some process, and I can see nothing better than promotion by selection in the junior grades up to and including commander.

The reasons for seniority promotion above the grade of commander, and the objections to selection, are too obvious and well known to need mentioning.

I, for one, am opposed to all the schemes for reducing the number of officers in the line, because I know from experience that we have not

enough officers afloat to secure the highest efficiency. If officers are too old for the duties they are called on to perform, the efficiency of the service—and that must be the first question considered and the one to which all others should give way—requires that they must be removed from the active list and their places filled by younger men. When we have a fleet of torpedo-catchers and torpedo-boats, and fifteen or twenty gunboats—and this number is now in sight—the question of "command rank while young" will soon be settled, for undoubtedly the authorities will see the advantages of giving all these commands to lieutenants, while the commanders and lieutenant-commanders will absorb many of those now held by captains.

I certainly agree absolutely with Lieutenant Fullam in all he says regarding the necessity for more officers afloat. Unfortunately we cannot discuss the question in all its bearings without being accused of opposing one corps or another of the Navy. In what I may say I wish to disclaim any idea of opposing anybody. I am only trying to give my ideas in a crude way on an abstract but very important question to the country. As an outsider looking at the question of paymasters on board ship, I cannot for the life of me understand why a graduate of Annapolis should not perform the duties of pay officer as well as a graduate of Princeton or Yale; and when I discover that graduates of Annapolis are actually, as executive and navigators, keeping accounts of, and making balance-sheets for, more property than the paymaster, my astonishment is increased.

As regards engineer officers on board ship, I do not think any are required, or, rather, none would be in a very short time if we had warrant machinists and the younger engineer officers taken into the line. All the watch officers of the ship would then belong to one corps, call them what you please, preferably line officers, as their titles seem to be so popular just now. The older engineer officers, who are being disabled at such a furious rate, could then perform their proper duties on shore, where they should, when consolidated with the Construction Corps, make ships and the things that go into them fit each other better than they do now. They could also be employed as instructors at colleges of which we hear so much.

The younger constructors should follow the course now wisely laid out for them by the Secretary of the Navy, and so find out some of the practical discomforts imposed upon sea-going men by their lack of practical knowledge.

I approach the question of marines with great hesitation for many reasons. That I am opposed to marines on board ship is pretty well known, but the reasons for my opposition are either not known or, if known, misrepresented. I find myself not in accord with Lieutenant Fullam as to the importance of landing parties, or more properly, landing drills. The business of officers and sailors is primarily on board ship, and in the new ships, if they attend to their business, they will find they have little time for shore work. Of course, enough of it must be done to enable the men to keep a fairly good military formation if

landed in case of riot, etc. Beyond this it is better to put the time on the turrets, rapid-fire guns and boats.

Coming back once more to the question of marines on board ship, their presence seems to me to be a question for each officer to settle for himself. Do you want marines, and, if so, why? I answer, without hesitation, No; I do not want them because I think sailors are better men for ship work. If we may rate developed intelligence in the enlisted force by dollars and cents—and I think we may fairly do so—then the more marines we have the lower the intelligence of the crew. One can scarcely call this desirable in the vessels we now have to go to sea in. It cannot reasonably be claimed that you can make a landsman any better by dressing him in a buttoned-up coat and putting a red stripe down his trousers. There must be something beyond that. What then is it that makes the greener man more valuable than the more seasoned one on board ship? If you want them to discipline your crew you must admit that they are better disciplined than those who have grown up from apprentice-boys under what I consider the best discipline in the world. As an old training-ship commander I deny absolutely any such proposition. Do you want marines to man your secondary battery. If so, you must admit that they are better for the purpose—better gunners and better shots. Few officers will admit this, I imagine, and those who do will not find the target reports with them. Do you want marines for turret guns' crews? If you do, you want the men of least experience to do the highest class of work on board your ship. If you want marines afloat it must be because you think two separate organizations are better on board ship than one, and, reasoning on this basis, three would be better still, therefore you should have a company of cavalry to further increase your efficiency. The effect upon the entire ship's company is bad, and you are placed in the remarkable position of claiming that one officer who graduates from Annapolis, and develops only one way, and can only do one class of duty on board ship, is better than, or as good as his classmate who is developed in many ways. It may be so, but after a considerable experience I am unwilling to admit it.

If the marines were formed into an expeditionary brigade of say five thousand men, with a brigadier-general to command it, and officered by the valuable corps of officers now in service, and used to garrison the posts near the different navy-yards, I believe it would be the finest body of soldiers in this country, ready at all times to suppress riots and guard Government property. When it became necessary to make a serious demonstration on shore, the proper number of men and officers, properly equipped and outfitted, could be embarked for the purpose, and when the job was done returned to their barracks.

I find myself in accord with Lieutenant Fullam on the subject of "The Bluejacket." The improvement in him, particularly in the petty officer class, during the past ten years, has been most marked, but there still remains much to be desired—better pay, better messing, better clothing, and better care from his officers all around. "Never trust a man in a blue shirt" has caused almost as much brutal harm as that other well-

known saying, "Spare the rod and spoil the child." I do not believe in beating children, and I do believe in trusting a man in a blue shirt. The more you trust the sailor, and the more responsibility you put upon him, especially when he is young, the more valuable he will be, and the more you can trust him as years go by. Let each officer make it his personal affair to see that the comfort of the men is looked after and I am sure the response will be prompt and manly, and let them encourage the notion that seamanship is not a lost art but the most important part of naval education, more important now than ever before.

What we want most of all in our new machines is the seaman, one whose seamanship includes most of what past conditions demanded, and, in addition, the finer seamanship demanded by the new conditions under which we serve. The "habit of the sea," and the art of "sea housekeeping," were qualities which marked their possessor in the old days, and they are of vastly greater importance in these new days of mastless battleships.

Finally, I am sure from my experience in the ships of the new Navy that warrant officers, and plenty of them, are most necessary to efficiency; their number should be increased and the warrants given to apprentices as a reward for professional attainments.

Commander J. B. Coghlan, U. S. N.—The subject of the essay under discussion—"The Organization, Training, and Discipline of the Navy Personnel as Viewed from the Ship"—has never, in my opinion, been touched upon, or its various needs enumerated and reviewed, in so able a manner as by the present essayist. The statements are lucid and the arguments unanswerable. In many minor points differences of opinion may exist, but as a whole every naval officer should be its champion. Discussion of it might imply a disagreement. What I submit is meant to be wholly, entirely and heartily in its favor. In some respects I wish it had gone further.

"Vested rights" have had many and powerful defenders, "vested duties" have had few or none.

The statutes creating the marine corps certainly create no vested right of service afloat on board our vessels. The same laws provide for their service in forts and garrisons on shore.

If serving on shore, the same pay and rations would be earned. As no manner of hardship to the corps itself would follow their removal from service afloat, there should be no feeling of bitterness engendered by a calm discussion of the question of their retention on board under the new conditions which have lately arisen.

The experience of every one shows that our modern vessels cannot accommodate the people actually required for proper service.

Even with the reduced crews of peace times the conditions have almost reached the limit of human endurance. What will it be in times of war?

The man-of-war's man of to-day is of very different material from the one of a few years ago; is vastly superior in every way. The mode of treatment of even twenty-five years ago is no longer necessary, and in

my opinion the constant surveillance of a distinct corps of police, antagonistic to the mass of the crew, is no longer necessary, in fact, is detrimental to the general efficiency of the vessels. The arguments in vogue to-day for the retention of marines on board ship, if carried to their logical conclusion, would land us in the days of Blake with ships filled with soldiers, instead of in the more glorious days of Nelson, Stuart, Hull and Bainbridge, with vessels full of seamen. As the essayist points out, there is no difference in the raw material of the recruits. The acquired difference is merely one of instruction.

Give equal time to the instruction of blue-jacket recruits as is given to the marine and the same results will obtain. To say that they will not is to decry the naval officer to the advantage of his brother of the marine corps. They are all men of intelligence, and the same ends will be reached by use of the same means. Since this must necessarily be the case, what are the advantages of retaining the marines as a distinct corps on board our vessels? Certainly the reports of target practice merely show that advantage lies only with the men who receive the most practice in the work. With their special arm, at which they have a vast amount of practice, the marines are slightly superior. With great guns, at which the average sailor man has the excess of practice, he is as markedly superior as is the marine with his special arm. As the original material the recruits were equal; it follows that were both classes equally drilled and instructed with each class of arms the difference would be nil.

I thoroughly believe that the sailor man can be taught anything. His life makes him a man of resources. The exigencies of sea service place him where his brain must work for his own salvation, and where it so works it enlarges; it never goes back, and thereafter he is all the more able to grasp other situations and surmount other difficulties. Create in our people the *esprit du corps* of the marines, and the guard duty of our vessels would, I am sure, be equally well performed by the blue-jackets. And this is the main, in fact the prime duty of the marine corps at the present time on board our vessels. The substitution of an equal number of blue-jackets for the marine guard would not in any way destroy the efficiency of the gunnery of our vessels, but the efficiency of the working force would be greatly increased. When thought of in this connection it seems marvellous that any naval officer should oppose it.

The assignment of thoroughly instructed "all round" useful officers, such as lieutenants and ensigns, to perform the duties of the present pay corps, would be of the greatest utility. "All round" service is now required almost daily. To see that the duties of pay or disbursing officers would be equally well performed by line officers we have but to glance at the "Report on the Modern Light-house Service" of Mr. A. B. Johnson, page 107.

Officers of the military branch would be better able to judge military stores, and they would be on the same footing regarding other stores as the newly-appointed paymasters, who, taken from civil pursuits, know nothing of any stores at all. Instruction and observation afterward supply this knowledge, which would also be the result in case of a lieutenant.

The "vested rights" of paymasters now in the service might well be protected in the manner pointed out by the essayist. But the proposition is good to the last degree and I heartily endorse it.

The essayist's remarks on the organization of the engineer corps are just and should be heeded. I have been thoroughly convinced for years that that corps as a corps of commissioned officers is entirely too large for the needs of the service. They are educated far beyond the requirements of engine driving, their principal duty on board ship, and rightly scorn it. That duty is performed the world over by men of the same grade and education as our machinists. And that such men fulfil all the duties and requirements in the fullest sense of the terms can be seen any moment by a glance at the records of the merchant marine of the world. In my opinion an engineer officer should be attached to each vessel (to some larger ones an assistant also), whose duty should be that of supervising and superintending the steam machinery, while the machinists stand the watches. This would give the commanding officer a reliable assistant in the engine department, and would give the engineer practical experience with machinery which he may have helped to design.

In my opinion, no such step in advance has of late years been made as the order of the Navy Department sending constructors to sea to study the working of vessels under the very conditions for which they are built. Good results must accrue from it.

The move lately made in Congress to increase the engineer corps and assign naval engineers as professors to colleges "to propagate a knowledge of steam engineering" may sound very well and may be catching, but it is bad for the Navy.

Why should the money appropriated for the Navy be squandered teaching schools outside?

Instead of being looked upon and sought after by the States as a benefit, it should be regarded as an insult, as another step toward centralization on the part of the General Government. The thousands upon thousands of merchant vessels in existence since the introduction of steam have been well run and well handled without schooling from the General Government—in fact, have led the way in steam engineering. No collegiate or scientific education is required or found necessary for running those engines, and none is required for the same work in the Navy.

Such a law would simply increase the expense of the Navy without the slightest corresponding advantage. With an engineer corps properly proportioned to the needs of our service, the Naval Academy could easily supply more than are required and of the proper scientific requirements for designers.

No "vested rights" need be interfered with in this case either, as the Bureau of Steam Engineering and the various navy-yards have many important and congenial positions to be fulfilled by such scientific men.

The day of the "all round" useful officer has indeed come, and the Navy should be proud of the perfect way in which the naval officer has

met it. He has grasped the subject of armor, guns, ammunition, mounts, projectiles, turrets, electrical machinery, turret gear, hoists, in fact everything pertaining to his profession, and in the space of a few years has placed our Navy ahead of the world in such matters. Since their installation on board, these implements have been well cared for and well handled by the naval officer, and yet we find people trying to have the control of them taken from those officers who originated, fought for and (in spite of all opposition) obtained them; from the officers who have since then cared for and used them with signal success; and turned over to a corps which is, by the reports of its chief, already overburdened with work to such an extent that it is absolutely necessary to increase its number; whose members, according to the daily reports of the newspapers both professional and lay, are breaking down under the frightful strain of the care of the multitudinous machinery already in their own department. Such reorganization would be a step backward. The naval officers in charge have demonstrated their ability to install and care for these things at no increase of cost and no increase of men in their corps. The corps to which they are sought to be transferred is asking for an increase to perform the duties already imposed, and with other duties added a still further increase would necessarily be required.

Since the naval officers now in charge care for this machinery without extra expense either in increase of their numbers or by breaking down and going on the retired list, let them keep it.

I was heartily glad the essayist has so just a view of the utility and desirability of warrant officers. His remarks on this subject deserve the most careful attention. I would like to see the number of boatswains, gunners and carpenters trebled. Not only are they of the utmost importance afloat, but the navy-yards, magazines and stations need them.

The introduction of warranted machinists would be exceedingly advantageous. The whole history or record of the warrant officers in the service shows them to be a body of intelligent, worthy, able men of perfect loyalty and discipline. They respect themselves and they have been respected by the service both low and high. Something must be done to retain our highly trained and intelligent young men in the service, and how can this be better done than by promoting them to such important positions?

Glance for a moment at the various positions at our navy-yards which could be filled by warrant machinists, for example. Our yards are full of secondary machinery, such as hoisters, derricks and fire-engines. These positions are filled by expensive men, employed by the day, with no earthly interest in anything but getting their pay and doing as little as possible in return.

In case of war and sudden need of men, would these *per diem* people jump to help the service? No; judging by past experience they would jump to get an increase of pay on account of war, and the Naval Establishment would be in the position of having fostered them in peace to gain no benefit from them in time of war. How different would be the

case were men actually in the service assigned to these places in time of peace.

Such positions as riggers of the different departments, laborers in store-houses and gangs, ordnance men and cartridge-makers, could and should be filled by men of the Navy whose services could be commanded afloat in time of necessity. These would constitute a splendid reserve, up to the latest improvements and ready at a moment's notice.

I heartily approve the motto "Let the Navy take Care of its Own." Employment in this way at the naval establishments of efficient navy men entitled to reward would be but a step in advance over the present mode of employment of ordinary outsiders at the navy-yards. And the expense of the whole establishment would be decreased. Steady employment never demands as high wages as does sporadic. The item of "Pay of the Navy" would be slightly increased, but the pay of the civil list would be more than correspondingly decreased.

Regarding the status, training and reward of the petty officers and men, the essay shows that its author has studied the question thoroughly, has looked at it from the proper standpoint, and has pointed out a general way for a permanent improvement.

In a small way his assertions are proven to be true by the status of the "gig's crew" on board of any man-of-war. That crew is trusted far beyond any other, and consequently is always the most reliable one on board. Compare the conduct and reliability of the mail messengers when blue-jackets are entrusted with this duty, with that of marines. Is there any difference? None. There are unreliable men under both uniforms, but the ratios do not differ.

In my opinion the essayist has handled his subject in a most masterly manner and deserving the thanks of all the well-wishers of the naval service.

I would detain you a moment longer to speak in praise of his idea of teaching the officers piloting and conning. The course pointed out would be of the very greatest advantage to the country.

In this respect my service in southeast Alaska and in the 8th Lighthouse district has been the best I ever had. I have been enabled to learn those parts of the country to a degree which I could not have done in fifteen years of ordinary man-of-war cruising.

Unfortunately, the subject of piloting has never received proper attention.

When going in or coming out of any harbor all the naval officers should be called upon to study the locality and the charts; should be on deck to see and understand the movements and changes of course, to note the various ranges, lights, beacons and other marks. In fact, the passing in or out of a harbor should be an object-lesson for each naval officer on board.

A double set of harbor charts should be supplied, so that the study could be made by the body of officers without in any way inconveniencing the commanding officer in a tight place. The essayist's idea is so good that I for one shall make use of it hereafter.

The 4th, 5th, 6th, 7th and 9th propositions of the Recapitulation should be framed and displayed in every cabin, wardroom, steerage and stateroom of the service, as a constant reminder of what is needed and as pointing out to the officers the road to brilliant success.

The other propositions being beyond the immediate power of the officers, should be thoroughly studied, that intelligent arguments in their favor might be submitted should the proper authorities ever call for them.

Lieut.-Comdr. W. J. BARNETTE, U. S. N.—While considering that portion of Mr. Fullam's most excellent paper relating to the subject of marines on board ship, I would like to say, as a result of my experience, that I have never found them as valuable as the space required for them. In a ship of the Maine class, where there is room and to spare, the marines can be endured, though I am satisfied that much better results would be obtained with a homogeneous personnel; but in vessels of the Raleigh and Cincinnati and smaller classes there can be no question that the ships would be much more efficient as fighting machines with blue-jackets substituted for the marines.

In the many exercises to determine the rapidity with which ammunition can be supplied to the battery in a given time it has been shown that with an addition of two (2) men to each gun of the main battery, and fifteen (15) to the powder division, making twenty-nine (29) in all, the supply of ammunition would be equal to any demand likely to be made upon it, and not otherwise.

These 29 additional men represent the strength of the marine guard in this class of ships, and the question naturally arises, why not put the marines to these duties? Because they object to being distributed in this manner, and there would then be no further reason for the existence of a marine officer on board ship; and where would be the sense in having a differently uniformed and trained body of men to do duties identical with those of the main body of the ship's company? And then again consider the immense help it would be to the working force of the ship to have their number increased one-fourth when it comes to scrubbing, cleaning and coaling, which constitute three-fourths of the whole work of the ship.

I venture to say that there is not to-day a ship in commission with full complement which could call away a cutter or whaleboat and be sure that a full crew would respond, owing to the hospital, sick and excused lists. Without marines there could not be this unfortunate state of affairs.

There has been no doubt in my mind for years that our ships would be much more efficient with the marines replaced by an equal number of blue-jackets, for I have never found the duties performed by the marines afloat at all proportionate to the space required for them; and I fail to understand the objections of the marines to being assigned exclusively to shore duty, for on shore they are much better off in every respect and can be exceedingly useful. The time is coming, and very shortly,

when, in addition to their present very important shore duties, they will be required to guard outlying coaling stations.

Ensign PHILIP ANDREWS, U. S. N.—I agree entirely with Lieut. Fullam in all that he says in his paper regarding the main features of any reorganization of the Navy, though not always attaching the same relative importance to his reasons for the different steps necessary for an efficient organization.

The number of engineer officers at present is not enough to have all engine-room watches at sea taken by *commissioned* engineers on all ships and give a moderate allowance of shore duty; but it must be remembered that a modern ship is more often in port, when engineers stand day's duty, and then there are twenty-five engineer cadets at sea who are given a watch as they show themselves proficient. The number of engineers is too great if the watches were stood by warrant machinists. If this latter system could be gradually introduced so as to do least harm to officers' interests by the change, and the engineer corps was limited to the design, construction, and supervision on board ship of marine engines, I believe that engineer officers—their education and inclination being entirely in that direction now—would be as well satisfied with their duty as men could be, and I think the efficiency of that branch and of the service would be improved.

The warrant machinist system is opposed by those engineers who are heard on the subject of a reorganization of the engineer corps, but it would perhaps be interesting if those who remain habitually in silent acquiescence would give their free and honest opinion as to its merits.

Certainly the experience of other navies would seem to show that it is the best plan.

I believe the marines should be withdrawn from all ships. I have been often impressed with the difference in physical development between the blue-jacket and marine, which difference is symbolic of the usefulness of each. On large, roomy ships, of which we now have few, the presence of marines is not felt to be such a distinct disadvantage; but in the smaller ones, or in ships of great coal capacity and paint area (like the Columbia and Minneapolis), the displacement of marines by all-around working men is generally felt to be a necessity.

In the next three years about thirteen per cent of the pay corps retires.

In the next ten years about forty-seven per cent of the pay corps retires.

Of those who have entered the pay corps in the past two or three years it is said that they will only have to have a total sea service of about six years and a total service of about ten years before their rank will entitle them to remain on shore duty.

It seems to me that advantage should be taken of these wholesale retirements to gradually withdraw paymasters from all ships but flagships, which might have a paymaster of the fleet, the remainder to be naval storekeepers and purchasing paymasters. No more paymasters need then be appointed unless it is found necessary to recruit the small

force needed for fleet paymasters and naval storekeepers. The work of accounts on board ship may then be given and easily performed by the officer of the powder division or other subordinate officer.

It is reported that the same system has been recommended by Secretary Lamont as a business measure for the reduction of the Quartermaster and Pay Departments of the Army, and it can be accomplished without damage to the vested rights of individuals.

While a stern regard for an efficient naval organization would trample ruthlessly on the so-called vested rights of individuals, it seems apparent, from the experience of the past half-dozen years, that Congress is not now prepared to take such immediate steps, and that the final perfected system, if ever arrived at, must be reached by more or less gradual stages.

From a casual examination of the retirement list of all branches of the service, it seems plain to me that if a start is not soon made Congress will, in from six to ten years hence, deal the Navy several crushing blows.

It is for the Navy to say whether it will wait to be hit on the head.

Ensign T. P. MAGRUDER, U. S. N.—Though disclaiming new ideas concerning the organization of the *personnel*, the essayist deserves credit and praise for giving the proper point of view from which to consider the subject. The ship is the common ground upon which all the conflicting views and opinions may be made, discussed and harmonized. It is not difficult to form an intelligent opinion upon a question as to its relation to the efficiency of the unit of naval power; yet the same question considered from another point of view may cause a decision correlative to efficiency.

The essayist's views concerning the disposition of the staff corps will undoubtedly call forth strong antagonism from those corps, since the argument is made that two corps should be withdrawn from ships and that the numbers of another corps afloat should be reduced. Consequently, those agreeing with the essayist—I do unequivocally—should in duty bound express their views. And, as is pointed out, particularly is this the duty of the line officer—in command, or being educated for the ultimate purpose of command—who being alone responsible for the efficiency of the ship as a whole, his opinions as to the methods of obtaining that result must prevail.

Were the pay corps reduced in numbers, say to twenty, lowest grade to rank with lieutenant-commander, their duties would be the important ones at the navy-yards and in charge of navy pay offices. Not being bred to the sea as a profession, it would seem that such a change could not be otherwise than agreeable to the pay corps.

It has been well said that naval engineers have a just cause for discontent, arising from the fact that many, under present conditions, must habitually perform mechanical duties and subordinate work in which their high education, excellent training and brilliant attainments—and the naval engineer has these—have but little scope. Warrant engineers would

relieve the officers of much of their routine work, which can be done equally well by skilled machinists, thus giving the officers time for study and research of the many intricate problems that confront their profession. The duties of the naval engineer would then naturally be the legitimate ones of an officer—those of directing and superintending the care and running of ship's machinery.

Withdrawing the marine officers from ships is not such a radical change as may at first appear. Of a corps of 76, there are now afloat only 16 officers in charge of guards, and six second lieutenants who, I take it, are on flagships for instruction. Thus it appears that the principal duties of the marine corps are on shore. The fact that a large number of commanding officers of the North Atlantic Squadron are known to favor strongly the replacing of marines by blue-jackets must be conclusive proof that the change will increase efficiency. That there is no longer a need for a specially trained corps of marines for service afloat we have the testimony of many officers who have sailed on ships that had no marines aboard.

There can be no dissentient opinions to the pleas of the essayist for the betterment of the condition and position of the blue-jacket and petty officer. Forcibly bringing to the notice of young officers the importance of caring for the welfare and comfort of the men will not be the least value of the essay. Personally, I am grateful to the essayist, and I take pleasure in the acknowledgment.

Commander F. E. Chadwick, U. S. N.—Lieutenant Fullam's serious and thoughtful paper deserves, and I hope will receive, a full and general discussion; it touches the essentials of the service, which we all recognize are now somewhat in a state of flux; with the new conditions of material we need, to some extent at least, new conditions amongst the men who use it.

First, I would compliment Lieutenant Fullam upon the self-contained character of his article; I think no one can take exception to its tone. This, in view of the much improper and wholly uncalled for expressions of which we see so much on the part of persons discussing such subjects should be noted and praised.

To take the subjects seriatim:

1.—Promotion of Officers.

I can see nothing for it in the future but a scheme of selection; there is no other logical system; and this selection I would carry from the bottom (where we have already had it for many years) upwards. The only question to my mind is how far, *i. e.* through how many grades this should be carried. Logically, through all. But in practice I believe the English are right; they stop with captain (their true command grade, their grade of commander being really assimilated to ours of lieutenant-commander). The French select also from captain to flag rank; but I have heard no French officer speak of this who did not

think the English system preferable. They have always stated that the jealousies among their captains arising from the strife for flag rank were a serious detriment to the well-being of the service. Such jealousies can have no such extended effect in lower grades, and it would seem well to make the grade of lieutenant-commander the last from which officers should be selected; thereafter certain age limits should apply, and facilities be given to older men to remove from the active sea-going list.

Much feeling has been aroused on this and the associated question of reorganization of the line of the Navy, but we must at least face the fact that something has to be done, a fact which was made clear to the whole service so long since as 1891. Many persons, particularly in Congress, seem to have regarded this movement as a self-seeking one on the part of a large portion of the line officers, but the fact should be remembered that the movement had its inception in the highest motives, was begun by the Secretary of the Navy and supported by the senior officers of the service, and that certain antagonisms have been developed only by force of circumstances beyond any control or forecast.

The last paragraph of Lieutenant Fullam on this subject is very admirable, and is, I think, not to be gainsaid.

2.—Officers Afloat.

We need more, not fewer. In fact, there must be a large increase of the line if anything like our present system is to be adhered to. We shall soon have afloat seventy-five per cent of all the officers on the Navy list below number 25 on the list of lieutenant-commanders. We shall be quite unable to keep up our present system of shore duty. This I have come to think will be a matter of strong regret. We differ essentially from the English in the fact that their officers are kept much more continually at sea; the shore administration is almost wholly civil. Each system has its good points, but I have come to believe that the defects in ours are much more than offset by the fact that our officers become much more intimately acquainted with all the details of the material they are called on to handle than those of any other service. I believe there is no officer, take him full and bye, who knows his ship and what she contains as the American. He has inspected her steel; he has designed and built her guns and mountings; has superintended the manufacture of her torpedoes; has inspected and installed her electrical plant. This can be said of the officers of no other service, at least in any like degree, and the result is good. An intimate knowledge of tools handled is one of the best bases for success in their use.

In regard to the utilization of line officers as pay officers, such a scheme has many advantages, but there is one point which requires much consideration; this is the status of such officer in the hierarchy of command. If he were confined to the duties of pay officer during the three years' cruise he would certainly not be the officer to succeed say the captain and executive if they were killed in action. He would, if in the line of command, certainly have to take such part in the ship's man-

agement as would enable him to keep his hand in, so to speak, and not find himself adrift in such a momentous emergency. It is not impossible, of course, to so arrange his duties at sea, or even to some degree in port.

There are questions as to bonds which may arise, but I do not see the necessity for the exaction of a bond. Already any officer may be called upon in certain emergencies so to serve without bond. Nor, to look at it in a common-sense way, will the ordinary bond exact anything more in the way of honesty and uprightness than the penalty of loss of commission if there be malfeasance.

Regarding engineers, it is in my opinion quite time that the bathos expended on this subject should end. No one will pretend to deny that the first and supreme quality for duty in the engine-room is to be a good mechanic. The duty at sea is a purely mechanical one, and no effort of any man can lift it on to any other plane. It has nothing to do with the conduct of the ship; it ends with keeping the machinery in proper working condition. It should be remembered that it is not the value of a machine which is of importance, but the use to which it is put, and with this use the engineer has nothing and can have nothing to do.

If we continue the education of engineer officers at the Naval Academy, there should be but one such officer on board ship. All the others should be of the present machinist class, a portion of whom should be warrant officers assimilated in rank, etc., with the warrant officers now existing. The idea that we need the whole educational facilities of the country made operative in the direction of turning out engineers for the Navy becomes simply ridiculous when it is known that the yearly waste needed to be made good is about six. These educational establishments would, besides, not furnish the kind we want. We could, in an emergency, get any number desirable and of much higher quality from the merchant service. The engine, as has been well said, does not know whether it is in a man-of-war or a mail steamer, and will run equally well in either under the same superintendence.

I am inclined to think that the utility of marines on board ship is a thing of the past. In any case they should never be there unless the ship be large enough for an officer's guard. If it be a question of marines or blue-jackets, by all means give us the latter—the marines as an *addendum* but not as displacers of the sailor man.

The experience of England has been too pronounced as to the value of the blue-jacket ashore for our officers to undervalue it; in fact, our ships should be overmanned in order to afford as large a landing force as possible.

The last paragraph of "Officers Afloat" is worthy of every one's attention; it embodies truths of utmost importance.

Training of Officers.

I agree with what is said as to the Naval Academy, except that I would make the course one of four years and raise the examination

for admission, taking in more subjects. If every 180,000 of our population cannot furnish once in four years a really well qualified boy between 15 and 17 to enter the Academy, the country is in a poor way from an educational standpoint.

I cannot agree altogether as to the "School of Piloting." I think our cruising ships should form this school. I think the abrogation of the order which required officers to do their own piloting a great mistake. We had under that order an excellent school now thrown away. The junior officers of ships in the North Atlantic Squadron could be as readily trained in pilotage aboard their own ships as in a specialized one, if we did the exercising we should do. Finally, we cannot afford so many different schools of application with our very small number of officers. Let us utilize present conditions as much as possible instead of adding to our complexities.

Warrant Officers.

The gunners and boatswains should be largely increased in number; they would form a far better class from which to add to the number of deck officers in case of war than any body of men taken from without the service, whatever their provenance.

I do not think there should be any compulsory promotion yearly of a certain number from the warrant officers or enlisted men to commissions. It must be remembered that any man who enters the Navy has also a chance to enter the Naval Academy. It is a thoroughly democratic institution, established to form officers in the best manner possible; it is open to every one in a district if a competition be held; if the Representative prefers to make the selection himself he is responsible for any abuse in making it or for any violation of our democratic principles. If the enlisted man has passed over his chance of seeking an appointment to the Academy he has no right to complain that he has been debarred from a commission. All the same, I think there should be a board from time to time to report upon warrant officers or enlisted men recommended by commanding officers as deserving to be considered for commissions. But there is no more inherent right to such promotion on the part of the enlisted man than there is on the part of the commissioned officer to be promoted to a next higher grade unless he be a specially qualified man. The rule is equally applicable to the enlisted man and to the officer; in the one case, however, it has been recognized and in the other not. In no case, however, should there be the promotion of a half-deserving man. His promise as an officer should be as great as that of the Naval Academy graduate, else there is no reason for promoting him; it is the good of the service which is involved, not the question of the advancement of a man or any set of men for sentimental reasons.

No railway promotes a brakeman to be an officer of the road for the mere sake of cheering the others; he must have the qualities and attainments needed in the new position. This seems to me common sense

which should apply to the Navy as well, unless we are prepared to accept socialism pure and simple.

It would be much more to the point were we to improve the enlisted man's position in general; give him more space, more comfort, treatment always wise and humane, and give to petty officers that consideration which their position properly demands. These principles applied to the whole body of ten or eleven thousand men would count for much more than the illusory sop of a yearly promotion of one in five thousand. All the same, give this, too, if the man is of a type to command it, for the "Good of the Service."

Commander C. H. Davis, U. S. N.—I have read Lieutenant Fullam's essay with great interest, and there can be no doubt that taking the ship as the test, Mr. Fullam's ideas are sound and in the right direction. Those of us who have been in the service long enough can follow by our own recollection the successive steps by which the "vested rights" of the several branches or "corps," which are not corps, have grown. There is but one corps in the Navy and that is the Navy itself; or if there are several corps, then each squadron or ship acting singly is a corps. That is a true military definition. No branch of the service can be a corps unless it acts together as a body, which the "corps" never do except in opposing legislation looking to the military efficiency of the Navy as a "corps." We have accepted this word, which has not yet been forced upon us by legislation, as the misnomers "staff" and "line" for the civil and military branches of the service have been. I say misnomers, because the staff seldom is a staff and the line never is a line. All these terms are simply indications of the general inefficiency and decadence into which the Navy drifted, with deliberate intent, in the twenty years following the close of the civil war—years of utter inanition and decay, in which military efficiency was deliberately lost sight of and ignored; so the civil branch, or "staff corps," in these years grew prosperous by the very argument that they formed no part of the military body; that they represented civil rights in a military body as opposed to a military oligarchy which sought to rule very much as a fungus will grow to great size on a rotten tree. And they continue to appeal to that argument to this day. It would be hard to conceive of a greater departure from military efficiency in a military body. But the Navy only lived through those years because nobody took enough interest in it to propose to abolish it outright. And there is another tremendous abuse still very dear to us all which these years produced and made legitimate so that it is recognized to-day; that is the abuse of "shore duty." "Shore duty" for sailors—the very idea is anomalous and absurd. Whenever a naval officer accepts "shore duty," or an appointment to shore duty, it should be with a distinct understanding that by so doing he drops out of the line of promotion and accepts retirement. You could always find plenty of retired officers for shore duty, and plenty of active officers who would be willing to retire for the sake of shore duty. Repeal the law prohibiting the employment of retired officers, and pass

an act prohibiting the employment of active officers on shore, except in certain high administrative posts, and you will have taken a very long stride indeed toward effective reorganization, and will remove a very great obstacle to reorganization, which must include an increased retired list.

2. Of course the question of reorganization, now that we have begun to build good ships and to form an effective material for the fleet, is a burning question, a vital question. There are only two questions as regards the naval service which are more vital, and I propose to say a word about them, too. But as regards reorganization I think Lieutenant Fullam has treated the subject very ably. I have myself almost reached the conclusion that reorganization will come about by the extinction of "corps." Let the naval officer be the all-round man assignable to any duty on board ship, either as a navigator or chief engineer (engine-room duty being performed by warrant machinists) or executive or paymaster, except the surgeon, who must of course remain distinct. It is not too much to ask of a modern naval officer that he shall be a practical engineer as well as a navigator, disciplinarian, and gunner. I say I have almost reached that conclusion, but not quite, because there are certain fundamental objections to this plan which are still too real. Mr. Fullam's suggestion touches this plan very closely. But I disagree with him as to the abolition of the marines. Of course the withdrawal of the marines from ships means the abolition of the corps, which is a corps in the true military sense, and the arguments for their withdrawal are almost overwhelming, at least they seemed so to me last winter in this ship when I had two-thirds of the entire guard of the ship in the brig for scandalous offenses against order and discipline, and sailors standing guard over them and doing duty as corporals of the guard. But there is an argument for their retention which has been advanced by a great living officer, which seems to me, notwithstanding these facts, unanswerable. So, also, although I agree in theory I would oppose in practice the assignment of active officers to duty as paymasters and paymaster's clerks. It is a good thing to have a paymaster with a military training and military instincts. I have enjoyed that privilege in this ship; but, on the other hand, naval officers do too much mere clerical duty as it is. It is not an impossible case now for a young officer to perform three years' duty in an office on shore, doing purely clerical work, and then be assigned as a clerk or secretary for a whole cruise at sea. What sort of experience is he laying up for himself against the time when he must act on his own responsibility as a seaman on the ocean? The retired list might be a solution of this difficulty also.

3. I have said there are two questions more vital, more pressing and real than the question of reorganization which Lieutenant Fullam has treated so ably. These questions are Naval Policy and Administration. Let Congress declare a distinct naval policy and enact such legislation as will allow the Navy to be administered on sound military and business principles, and every other defect will almost rectify itself. In other words, the real demand for efficiency which has never existed will create efficiency.

Lieutenant W. H. HALSEY, U. S. N.—The article written by Lieutenant Fullam places clearly before the reader conditions that exist and that should be met in order that the best results may be obtained from the material at hand. From the writer's point of view, the salient points of Lieutenant Fullam's essay are practically beyond criticism, for they all are stamped with the hall-mark of sterling worth, and it is only intended to add a few facts from practical experiences at sea to support the theories advanced.

Service on four of our modern ships, in two squadrons, has made it apparent that efficiency can only be obtained by constant watchfulness, unceasing care, and thorough work. These conditions require a homogeneous organization in which each individual contributes his quota. The days of the "berth-deck aristocracy" have gone by, and the idlers of the past should be replaced by men that work, not at intervals, but working men that bear the burden with their fellows.

The petty officer of to-day possesses the necessary intelligence and education that should fit him for the office it was intended he should fill, an office, taken in its broadest sense, that includes reliability as its chief requisite. From successful individual instances it seems logical to argue that, with proper training and handling, with trust and confidence, the petty officers as a class can be brought to the desired standard. That this standard will add to the efficiency of the ship needs no comment.

There will probably be unfortunate experiences and set-backs while in the stage of transition, but the history of the Navy seems to point to the fact that having passed through the dark ages of wooden ships and antiquated guns to the present time, when our ships and ordnance command the respect of the world, we shall be enabled to tackle these conditions with every prospect of success.

The writer served on the Miantonomoh, on which vessel were no marines; orderly duty was performed by members of the gig's crew. There were no cadets attached to the ship, and the number of commissioned officers was reduced to a minimum. The petty officers were given duties commensurate with their positions, and, as a result, the conditions and discipline on the Miantonomoh were nearer the ideal ship than on any other vessel to which the writer has been attached during his service of nearly twenty-seven years. Eighty-five per cent of the crew were on the first class; drunkenness was unknown, except an occasional habitual returning from liberty, and the ship was efficient and happy.

During the early part of the occupation of Korea by the Japanese a guard of fifty men (twenty-five marines and twenty-five blue-jackets) was sent from the Baltimore, at Chemulpo, to Seoul, the capital, situated about twenty-seven miles from the port. The fleet marine officer commanded this detail at the legation, and had with him as assistants three junior line officers, a medical officer, and a paymaster's clerk as commissary. This guard remained away from the ship for over two months, and during that time eight cases of drunkenness occurred in camp;

all the offenders were marines. Sentry duty was performed equally by marine and blue-jacket, and the only man returned to the ship as being absolutely unreliable was a marine, "an old soldier."

During the investment of Wei-Hai-Wei from January 22d until February 16th, and until the departure of the flagship on February 27th, the United States Navy was represented at Chefoo by the Baltimore, Charleston, and Yorktown. Each of these ships was without its marine guard, that from the Baltimore being at Tien Tsin on the Monocacy, the Charleston's guard being at Seoul, and the marines from the Yorktown ashore at Cheefoo, with a line officer in command. Incidentally it may be of interest to state that each of five nations had landed one officer and fifteen men at Chefoo to guard foreign interests. These troops were to co-operate for mutual support, and all reported to the American lieutenant as the representative of the senior officer present.

During the time mentioned the duties that devolved upon these three ships were very trying; the anchorage was bad, heavy gales prevailed, the cold was intense, but there was no let-up on the blue-jacket. The Charleston and Yorktown made several trips, and in hail and snow storms, with decks and sides covered with ice, rescued several parties of missionaries, the Charleston on one occasion being caught and held in the ice for several hours. Information was obtained for the commander-in-chief, and, so far as was deemed advisable, the operations of the belligerents at Wei-Hai-Wei were watched. The Baltimore remained at Chefoo, prepared at any moment to re-enforce the troops ashore. Danger of murder and looting by the fleeing Chinese soldiers was apprehended by the foreign inhabitants of Chefoo, and all arrangements were made to land a large force from the international fleet there assembled. For this purpose the gun divisions were detailed under their respective officers for duty at regular intervals day and night; arms were kept in the racks, with filled cartridge belts, canteens and haversacks, so that the emergency could have been met.

The Baltimore's marine guard (forty-two men) left that vessel on December 4th, 1894, and were transferred to the Monocacy at Tien-tsin, to be ready for duty at Peking should the minister deem their presence necessary for protection. The guard did not return to the flagship until late in the following April. During this time the Baltimore guarded American interests at Chefoo and Chemulpo, was repaired at Nagasaki, and docked at Yokosuka. Forty-two marines were away from the ship, and yet the discipline was not relaxed nor was the work neglected. Petty officers were detailed as corporals of the guard, sentries placed on gangway and brig, and orderlies from the barge and gig crews did duty for admiral and captain. These men not only stood their posts, but also attended to their arms and battery, worked in parts of the ship with all hands, and, with the exception of first and mid-watch details, scrubbed decks in the morning, and this when the ship was short of complement of blue-jackets. It was hard on the crew, but they rose to the emergency and necessity required it. Could the forty-two marines have been replaced by an equal number of blue-jackets the work would

have been very much lightened. The men placed on duty averaged fully as well as the marines, and in many cases even better, while more work was required of them. Strict discipline was enforced, and the strong hand of the commanding officer punished severely all derelictions of duty. The responsible duties of mail orderly for the office of the commander-in-chief were performed by a young apprentice, and while the mail and telegraph account amounted during the time to nearly two thousand dollars, this apprentice was found always reliable and accurate; he was intelligent, thoroughly trustworthy, and was proud of the responsibility placed upon him. At one time the Baltimore was in company with six flag officers, and most rigidly was all official etiquette carried out, the division having the day's duty being paraded under its own officers.

On one vessel of the Asiatic squadron a pay officer was dismissed, and it was several months before the pay officer detailed by the Department could reach his vessel. During this time the duties of the pay officer were performed by the navigator, though he still navigated the ship, looked after all his numerous other duties and made all necessary purchases. This, too, at a time when active, important cruising duty was being done by the ship, duties that involved separation from the flagship. The navigator in question was fully equal to the emergency, and no complaint was heard from him of the increased work. The conditions as quoted having existed during times approximating more nearly to active service, what is to prevent these exceptions from being made the rule?

On the New York there are at present seven chains of supply for ammunition for main and secondary batteries, located forward, nearly amidships, and aft. Ammunition for the turret and 4-inch guns is supplied by motors, with provision for whips and cranks in case of break down. From the forward magazines and shell-rooms are whipped up also supplies for 1- and 6-pdrs. and the 8-inch sponson guns, the former being delivered on the gun deck, the latter on the berth deck, where it is transported on trucks to the midship's scuttles and there whipped up. Ammunition for the after 1- and 6-pdrs. is whipped up from the after rooms. On the forward platform the gunner is stationed; the after division is commanded by an ensign; a naval cadet is in charge of the chain of supply for the sponson guns; a junior commissioned officer is in the central station. The officer in charge of the division has general supervision, with the senior assistant, to help with torpedoes and to assume command in case of accident to the lieutenant in charge. On the gun deck a chief petty officer has charge of the chain of supply forward for the 6- and 1-pdrs.; the same condition exists aft on the berth deck. The chief master-at-arms controls the whips at the forward hatch on berth deck. The men in magazines and shell-rooms are able, intelligent and active, generally gunner's mates; the torpedo men are reliable and efficient; the several masters-at-arms render admirable service, as do also the mechanics of the carpenter's force, but the rest of the division proper is composed of stewards, cooks, mess attendants and

bandsmen, with the second relief of the engineer force. In this division one is not struck with the homogeneity of its composition, and yet admirable results are obtained, for the officers are so spaced as to control the men; to reduce the number of officers would, to say the least, be inadvisable.

The initial object of a man-of-war is to be able to give battle, and it seems to be pretty well established that an ample supply of ammunition is a necessity for a vessel engaging an enemy, while the utility of musketry in naval battles is not apparent. Owing to the present complement of vessels and the number of enlisted men allowed the Navy, no more men are available. On the New York not another man can be spared for the powder division. Those stationed below the protective decks in magazines and shell-rooms we can assume will be well cared for, but the officers and men on the berth deck have no protection and casualties are inevitable. With the loss of officers and leading men, we have, there being no one to replace them, confusion, panic, and, perhaps, the source of a defeat; meanwhile, the marine guard, musket in hand, is deployed for alleged sharpshooting purposes behind improvised barricades. It seems nothing but practical common sense that the men thus wasted should be utilized and be replaced by educated, intelligent seamen, that as petty officers and leading men can render most efficient service in the powder division, where we may one day find, by bitter experience, that such service will be required.

Lieutenant J. M. Bowyer, U. S. N.—I have read the essay by Lieut. Fullam and I fully agree with him in all he says.

In the days of press-gangs and of sails there was reason for having a special body of trusted men to do sentinel and police duties. The bluejacket was an irresponsible, careless, devil-may-care fellow whose duties required him to spend most of his time aloft, or in handling, mending and overhauling sails and rigging. He had no time or inclination for sentinel's duties or anything pertaining to the military.

Now, however, the conditions are changed. Jack seldom goes aloft; he has to command men *on deck* instead of aloft; he has time and inclination for military duties, and he wishes to be rid of his *guardian*, the marine, and to be considered a full-grown man in the military as well as the sailor point of view.

The marine is unquestionably a barrier between the bluejacket and his proper status as a military man on board ship. Is it not strange that the only time he is ever trusted equally with the marine is when he is *ashore* and both are performing military duty? Then he is called upon to perform duties which, owing to the presence of marines on board, he has never previously been required to perform.

The Raleigh recently had a four hours' forced draught run at sea. The conditions of efficiency for battle were:

1. Every man of the "engineer's detail to the powder division" was required below to manage boilers and engines and handle coal.

2. Twelve men of the seaman branch, belonging to gun divisions, were

sent below to assist the engineer's force. Consequently the gun divisions were short twelve men and the powder division *thirty-two* men. The marine guard of *thirty* men was intact, but not available for all work that may be required of men of the seaman branch, whether it be at the guns, in powder division, or in coal bunkers and fire-rooms.

It is almost a certainty that in battle a cruiser at least will be under forced draught. It is equally certain that a large force will be required to run the engines, handle coal, etc., and that reliefs for this force may have to be sent below.

Marines are exempt from fire-room duty because it is "unsuitable to their military character" (see Art. 508, Navy Regs.), and they cannot be assigned to powder and gun divisions because they only, of all the men on board, must serve "under their own officers"!

If marines were withdrawn from the ships and the quarters now occupied by them were turned over to the principal petty officers, there is no estimating the improvement in discipline that would result from thus separating the latter from their men.

There is no other reason than the presence of marines on board ship for the difference in status between the non-commissioned officer of the Army and the petty officer of the Navy.

Lieutenant A. L. KEY, U. S. N.—I have read with much interest Lieut. Fullam's article entitled "The Organization, Training and Discipline of the Navy Personnel as Viewed from the Ship." He deals with these questions in a manly and courteous spirit, highly to be commended, for though the correct solution of these problems is of vital importance, they are unfortunately often discussed with much bitterness and little logic by the members of the several corps of the Navy.

The ship is undoubtedly the correct standpoint from which to view the various questions involved in a general reorganization of the sea-going personnel, and by confining attention entirely to the ship the problem becomes greatly simplified.

Mr. Fullam gives a clear statement of the facts from which he deduces certain general conclusions that are strictly logical and, in my opinion, thoroughly convincing.

I am not inclined to entirely agree with all the writer's ideas concerning a considerable increase of the warrant officers. Space on board ship must be considered. Warrant officers are assigned quarters and servants, and a large addition to their number means an encroachment on the living space for the crew, and also an additional number of servants on board ship without military training and of small value as a fighting force. I believe the interests of the men and the fighting efficiency of the ship would be better served by raising the status of the chief petty officers, giving them better pay and the benefits of the retired list, increasing their responsibility and authority, and exacting a high standard of conduct and ability.

The arguments for withdrawing the marines from the ships appear to me unanswerable, and his conclusions upon the subject are undoubtedly shared by a decided majority of the sea-going officers.

I think Mr. Fullam's essay a most excellent and timely one. I hope it will have effect in causing the problem of personnel reorganization to be thoroughly considered and discussed, as it may be in the pages of the Institute, without animosity or bitterness.

Commander CHAS. M. THOMAS, U. S. N.—It is with great pleasure and satisfaction that I have read an advanced copy of Lieut. Fullam's admirable essay upon the navy personnel, and I unhesitatingly pronounce myself in thorough accord with the essayist upon every point touched upon.

The steady improvement in the character and general efficiency of the enlisted force during the past twenty years is not questioned by any one, but the highest ideal of efficiency will never be reached until the marine guard afloat is a thing of the past.

The necessity of the marine on board ship disappeared when the custom of treating the bluejacket like a brute ceased to be the almost universal rule of the service, and when quarterly liberty ceased to be the signal for a drunken mob on shore, followed by a "brig" filled with howling sailors.

The presence of the marine afloat is now, and always will be, a standing reproach to the line officers of the Navy just so long as he is regarded as an "aid to discipline," and I am convinced that there is no duty now performed by the marine afloat that cannot be equally as well performed by the bluejacket after a limited period of the proper training.

The absurdity of implicitly trusting the marine and never trusting the bluejacket has not disappeared entirely, I regret to say, but this view of the same class of men, clothed in different uniforms, is rapidly weakening each succeeding year.

Let us suppose the case of two young men, brothers, about equal in character, intelligence and home training, deciding to enlist in the Government service. The younger of the two prefers the marine corps and presents himself at the Marine Barracks, New York Navy-yard, and is accepted as a recruit; the elder brother concludes to try the Navy, and presents himself on board the Vermont and is enlisted as a landsman. A vessel is to be commissioned at the New York Yard a few months later, and it so happens that the two brothers are detailed for that vessel, one as a member of the crew, the other as a member of the guard. What will be the result in nine cases out of ten? The marine brother will perform guard duty and will be trusted; the bluejacket brother will never perform guard duty, and will be viewed with suspicion upon every occasion when it is possible to obtain liquor or leave the ship surreptitiously.

It is the same old story, and there will be no marked change until the marine ceases to *watch* the sailor-man; the one is expected to be reliable and the other not.

I hold that there is no greater foe to true discipline than a constant evidence of suspicion and distrust.

In the last ship I had the honor to command, one of my early acts was to give an order that there should be no searching of

men for liquor upon returning from liberty, and I appealed to the petty officers to discountenance the smuggling of liquor and to use their best endeavors to make it unfashionable. The result surpassed my highest anticipations, and I believe that there was as little smuggling of rum on that vessel as any in the service.

Treat the petty officers and men with respect and they will respect themselves; treat them with suspicion and disdain and they will take advantage of every opportunity to elude your vigilance, and many good men will desert in sheer disgust.

The essayist alludes to an occasion when an executive officer reprimanded a cadet for placing some responsibility upon a petty officer and added, "Haven't you learned yet, sir, never to trust a bluejacket?" I do not hesitate to say that if such an incident had occurred under my observation as a commanding officer, I would have suspended from duty the executive officer and informed him in very plain language that an effort on his part to effect a transfer would be most agreeable to me.

The good work of steady improvement in the personnel is advancing slowly but surely, and, in my opinion, the day is not far distant when the marine afloat will have disappeared, and our petty officers will equal in tone, bearing and efficiency the celebrated drill-sergeants of the English Army.

I am second to none in my admiration for the splendid history of the marine corps, and I believe that its efficiency was never better than it is to-day, but its sphere of usefulness is on shore and not afloat.

When my thoughts revert to the early days of my naval career, and I recall the treatment of the bluejackets in the "sixties," and compare the same with their treatment of the present day, the difference is simply a revolution.

The most efficient ships are invariably the happiest, and the motto of every officer should be, "Happiness is the corner-stone of efficiency."

Lieutenant H. S. Knapp, U. S. N.—I am glad of the opportunity to add my voice in approval of the general features of this paper in which Lieut. Fullam has discussed a matter of vital importance to the efficiency of the Navy.

Stagnation in promotion is universally admitted to be a grand cause of inefficiency. It need only be added that it would quickly be remedied if all officers would attack the problem and direct their individual and united efforts with an eye single to the best interests of the service.

Mr. Fullam's position regarding pay and marine officers is absolutely sound. The duties of the former are indispensable; the officers themselves should have a broader field and a broader usefulness than now. Nobody questions the ability of the graduates of the Naval Academy to perform the duties of pay officers. Why, then, not have those duties performed by officers who, by training and education, would be available for general duty? At the very least, if the pay corps must be maintained entirely distinct, as now, the surplus graduates of the Academy should have the preference in making new appointments.

As regards the marines, every additional day's experience strengthens my conviction that they detract from rather than add to the discipline of ship life, and that they are room-takers and "idlers" in the sense of not being available for general duty. I hope the marine corps will never be abolished; I hope more to see it dispensed with as a part of our sea-going force. In intelligence I believe the bluejacket recruits will average superior, and I fail to see how a particular livery is to inspire virtues that another will not. To say that bluejackets cannot be made trustworthy is to charge, or admit, incompetence. I have no reason to admit it, nor will I. Sending ships to sea without marines is no experiment. Attached to the N. A. station is a ship in full commission without a marine on board; the discipline is excellent and I have yet to hear complaints from her officers that the bluejackets are untrustworthy. This cry is a bugaboo; men are very largely what circumstances and training make them, and the blue shirt covers just as great possibilities as the shell jacket. Let us, then, have our ships manned by as homogeneous a body of men as possible. There is no room for a corps of men on board ship who are there avowedly to do only a part of the duties of ship life, and whose duties, such as they are, can be quite as well done by bluejackets.

The warrant officers are a particularly deserving class, and I should be glad to see their numbers greatly increased. The Navy still has a place for boatswains and carpenters, and the necessity for gunners was never as great as it is to-day. Under Navy conditions I do not believe promotion to a commission from the ranks is practicable; hence a warrant is the aim of an ambitious enlisted man. But the small number of warrants now conferred annually is rather an infinitesimal objective for 10,000 men. Did numbers allow, warrant officers would be more useful on small ships than the same number of junior officers; on large ships they can scarcely be dispensed with.

I have long believed in a small corps of commissioned and a large corps of warranted engineer officers. It is an absurdity to give commissioned engineers the technical education they receive merely to run engines and do the drudgery demanded of engineer watch officers at present. To put commissioned engineers on board ships in a superintending and advisory capacity only would greatly enhance their responsibility, their comfort and the dignity of their profession. As for machinists, they are a superior class of enlisted men under their present status. But it is hard to keep the best of them, as every officer knows, for they can do better for themselves in civil life, both in pay and in comfort. Their duties on board ship are arduous and require unremitting attention, and they are subject to sudden calls by night as well as by day; and as petty officers of the watch they must exercise control over considerable bodies of men. Yet they mess and berth under the same general conditions as the rest of the crew. I have known of a machinist going ashore to hire a room after working all night in an emergency because there was no place on board ship where he could get sleep in the daytime. With warrant rank as an inducement, I believe it would be possible to get and hold a superior class who would do all the duties performed by machinists now and, in

addition, a very large part of the work that our system entails upon the engineer watch officers. It seems strange that the bitterest opponents of this scheme are the commissioned engineers.

It is a very great pity that it has seemed necessary to send apprentices, 3d class, to sea-going ships. They are too young and undeveloped to give efficient service, as a rule, and the weary months they must spend before an advancement in rating, during which they must accumulate two months' pay on the books, and after that clothe themselves, do their share in the mess, and find pocket money, all on nine dollars a month, are a period of hardship to the boys and annoyance to their division officers. An apprentice, 3d class, is not fit in any sense to take up his life as one of a regular ship's company.

In his commendation of the War College Mr. Fullam will have many and an increasing number of backers. Our material got to such a very low ebb for so many years that the energies of the Navy were almost entirely devoted to its improvement, while the question of how to use what we had and might have was rather lost sight of. The War College has done splendid work in directing attention to the broader questions of our profession, and its utility and necessity in that line cannot be too strongly insisted upon by its friends.

Lieutenant F. J. HAESELER, U. S. N.—The views expressed in Lieut. Fullam's paper are so thoroughly in accord with those of the line officers of the service, in general, that it seems unnecessary to attempt to criticise the paper under discussion. At the same time, as Mr. Fullam speaks of some officer having made the statement that the bluejackets cannot be relied upon for guard and police duty, I desire to testify to the contrary, as has been illustrated on board the Amphitrite, to which I am now attached. We have on this ship the most contented crew I have ever seen. From this statement it must not be argued that therefore we have better men than other ships, thereby making the police duty easier. For on looking over the enlistment papers we find amongst the men who have the best records on board this ship that their past conduct has been anything but good. We have but one post—that of orderly on the cabin door, and he is on post only from "all hands" to "pipe down." When coaling ship, or when alongside the dock, there is a sentry on the forward gangway, and the quartermaster looks out aft. These sentries are taken from the seamen of the ship, and are put on duty for a week at a time, in three watches. During the year we have been in commission we have had but three or four cases of the men getting past the sentry, and when one considers the fact that the men can step off the side of the Amphitrite, anywhere in her length, into a boat or upon the dock, this seems the more remarkable. We have had frequent cases of men being held up by the sentry and prevented from leaving, and in one case where a man did get by the sentry, three of them had started up the dock on a run trying to pass him; *he got two of them* and the third got by. Immediately after this episode another ship of the same squadron, having marines as sentries, went alongside the same wharf, and her men

were constantly running by the sentries without, in any case, being stopped. The orderlies on the cabin door form the gig's crew, and are not excused from any routine work in the morning watch, and are regular members of the different guns' crews. When the captain leaves the ship his orderlies man his boat and the bugler goes on post. The mail orderly is an apprentice, and it is interesting to note that all the mail orderlies we have had have been thoroughly reliable, never losing a letter or getting their accounts mixed in any manner. They have been accommodating, reliable and efficient, and have never had the slightest trace of liquor about them on returning from the shore on duty. This will seem all the more significant when it is known that in one case the mail orderly in question is a fairly hard drinker when off duty. The ship's corporal usually comes back to the ship from liberty over time and with every evidence of having been on a "spree," and yet this same man has brought men to the mast for attempting to smuggle liquor, and carries out his duties thoroughly and without fear or favor. Men are not searched at the gangway, but in case any member of a boat's crew is caught attempting to smuggle liquor, which has occurred once or twice, the *coxswain* of the boat is very heavily punished, which discourages the practice and reduces the smuggling to a minimum.

If marines were to be stationed on board this ship according to her rate, or according to the number of posts that would *then* be found necessary, we would have to withdraw at least twenty-five men from the seaman class. At sea, going down to Port Royal last summer, the men played out so fast in the fire-room that the deck force had to be drawn on, and finally there remained only enough men on deck to man the life-boat in each watch. This was allowing one man at the life buoy, one at the wheel, one on the look-out, two at the boat's fall to lower the boat, and one overboard. Had we marines instead of twenty-five of our bluejackets we would not have had a life-boat's crew left. When this ship is coaling the only men who do not work are one orderly, who stands orderly and messenger watch all day, the quartermasters, the sentry and his relief, the dynamo attendants, and chief petty officers. The chief boatswain's mate is in general charge, and all the other petty officers, including the armorer, gunners' mates, jack of the dust, coxswains, boatswains' mates, messengers, etc., are all at work with shovel or wheelbarrow, and the consequence is that the coal comes in lively and there is *no discontent* due to seeing a lot of idlers lying around. *A marine guard on board this ship would increase the time of coaling fully 33⅓ per cent.* Another point often raised against the bluejacket is that he will not assist to arrest a messmate. This may be so if the man he is to assist is a marine. I happened to witness a little incident on the quarter-deck of this ship when a big burly seaman, over six feet tall and weighing over two hundred and fifty pounds, was brought aft fighting drunk, having just returned from liberty. He assaulted the master-at-arms at the mast, and the officer of the deck directed the messenger and orderly, standing by, to assist in the arrest. They both jumped in without the slightest hesitation and pulled the big fellow down, and one of them getting hold

of the end of a boat's fall lying handy, got a turn around his legs and through an eye-bolt in the deck in a manner that I doubt if any marine could ever have attempted. The argument advanced against this evidence of what a bluejacket will do when put on police duty is that if the marines are required to perform the same duties as the sailor, and are given similar suitable clothing, and pay corresponding to the harder and more difficult work, that they will do equally as well as the bluejacket. If this is all so, where would be the difference between the two? Why have a division of men on board ship exactly the same as the bluejacket, with all the duties, dress and pay of the bluejacket, and the only difference being that such a division is commanded by an officer who is available *only* for the duty that an army officer is capable of performing? It would require a separate store-room, separate accounts and returns, separate liberty lists, and a hundred other special reports and channels of red tape to help confuse the already too intricate system now in use. Is the marine officer so much in advance of his brother officer of the line in intelligence, in control of men, and in knowledge of the modern intricate guns and mounts, their care, handling and repair, that he should take the place of one of the line officers, who is useful not only in the battery, but in the handling of the ship, and, in case of an emergency, in the handling of the engines? The marine officer can have but one duty—that of drilling his guard either at infantry or at great guns. The line officer is liable to be called upon for *any* duty performed by any one of the officers of the greatest battle-ship that floats, with the exception of the duties of the surgeon, and even in those he has rudimentary instruction. The same relative difference exists between the bluejacket and the marine. It would be but a fair test to have one of our battleships manned entirely by bluejackets, and should such an experiment prove a success, as it certainly has on this ship, I think it would convince the very few who are so conservative that they cannot see that while the marine *was* necessary for the police and sharpshooter work of a man-of-war fifteen years ago, the apprentice and better enlistment systems and rapid-fire guns have rendered his presence not only unnecessary, but prejudicial to the development of the petty officer and bluejacket, the men on whom, after all, we must largely rely in time of battle, no matter if the marine is retained as a factor in the ship's complement or not.

I do not agree with Mr. Fullam that if in time of war the number of commissioned officers becomes increased from the warrant officers, that at the end of the trouble those so commissioned would resume their original positions. It would not be illegal, but a great injustice to put men in positions of trust and responsibility in time of war and then reduce them in rank after faithful service. It would look as though the duties of the line officer in time of peace could not be performed by the men who could fulfill them satisfactorily in time of war—a manifestly impossible condition.

Commander C. F. Goodrich, U. S. N.—There can be no doubt touching the soundness of the essayist's contention that the efficiency of the

ship should be the criterion of naval organization. By it, all schemes of reform should be judged. It seems odd that so axiomatic a proposition is not universally accepted, but we must not forget that our troubles are largely due to ourselves; that we have encouraged and promoted the notion that duty afloat is but a minor incident in our lives; that the real prizes of the Navy are not to be found on the water; and that his sea service has been but too often regarded as a measure of the individual's inability to secure comfortable and continuing employment on land. A better spirit has begun to manifest itself, but even yet the most successful naval careers of the present day are not characterized by creditable or brilliant work afloat so much as by the occupation of desirable billets on shore. It should be our aim to gauge an officer's merits more by the discharge of his naval duties and less by what he does when not on board ship. The first breath of war will dissipate this mental fog. The officers who have shown coolness, courage, discretion and ability on the deck of a ship and in the handling of men and fleets will then receive their just recognition, and in them will center our hopes for relief from impending danger. Until that day arrives the existing false idols will continue to be worshipped, although, through concerted effort, we may minimize the cult and its attendant detriment to the *esprit de corps*.

As to the form which naval reorganization will assume, if any, I have but one word of advice to offer. Lay your schemes before the Secretary of the Navy. When he submits a plan for congressional action, accept his decision as final and lend your aid in getting his measure passed, no matter what be your individual views or the sacrifice it may exact of you. In any event, abstain from opposition. In our present condition anything is better than nothing. Without the Secretary's recommendation no bill can become law. It is not impossible, too, that, having all the suggestions before him, he may reach a conclusion wiser, in the main, than any one particular project.

It would be difficult for me to take issue with the general trend of this paper, for I am on record as favoring its purpose and its essential features. In my opinion, there should be no naval officers except those who go to sea, and every effort should be made to place as many as practicable of the officers on board ship among the combatants. The medical and engineer corps are specialists whose attention, during action, will be abundantly occupied in keeping the machinery of ships and men in operation. They are as vital to the fighting efficiency of the vessel as the line officers—no less and no more. As we grow older in the service, the value of these colleagues becomes more apparent and better recognized.

Of the paymaster the same cannot be said. In his case the question is rather, "In the long run would it be more expedient to place upon the line officer the responsibility of government funds than to have a separate corps for paymaster's duties?" The answer does not follow of necessity. There is a moral side which should not be overlooked. Men are but human, and often weak. The lapse from virtue of a line officer acting as paymaster is not inconceivable, however improbable. What would be

the effect on the service, as a whole, should some lieutenant fail to respond to the demands made on his integrity? While certain as to the desirability of having all officers, excepting engineers and surgeons, available for naval duties, I cannot urge the substitution of the line officer for the paymaster without indicating a possible grave disadvantage. Personally I do not apprehend disaster, and I am quite ready to make the experiment. But in avoiding Scylla let us not fall foul of Charybdis. We must provide against a too frequent recurrence of this duty on the part of the individual, or we shall have, practically, the same set of line officers doing, habitually, the duty of paymasters; in other words, a virtual re-establishment of a distinct corps.

I have always been of opinion that the engineers are of too good material and too high an education to be consigned to the dreary round of watch keeping. There should be enough of them on board to supervise and direct, but the actual running of the engines ought to be entrusted to the present class of machinists, to whom the prospect should be held out of warrants for the most deserving. There is no greater comfort to a captain than a capable chief engineer and an efficient engineer's division such as I had lately the honor to have under my command. My experience afloat has served but to enhance an already good appreciation of the worth of the engineer officer, and I should not speak as I do if I did not feel that I am, in a humble way, advocating his own best interests.

The proposed amalgamation of the construction and engineer corps offers some advantages. It would at least get the constructors to sea occasionally, where they can learn that important and infrequently studied branch of their profession which concerns the behavior and habitality of ships. We are training up a body of men to design our fleet who, in spite of their ability and intelligence, are, and must continue to be, in practical ignorance of what a ship is under service conditions until they all spend a substantial fraction of their time afloat. The Department's orders in this connection initiate a practice full of benefit to the service.

Those who command and fight the ship have little enough now to say about what the Navy needs in the way of new constructions. Would their voice be more heeded if one bureau absorbed all the details of hull and engines? Does not the present division of responsibility provide a mutual break on the activities of our two principal building officers, producing a certain useful conservatism? The question raised is a broad one. It should not be answered hastily. I am not ready to advocate this amalgamation, for I think the matter has not yet received its due meed of discussion.

The essayist proposes to do away with the marine. His logic is strong, but may it not be just a trifle *ad captandum?* That such a consummation can ever be brought about I have no expectation or desire. As now appointed, the marine officer is a graduate of the Naval Academy, and at the outset as capable as his classmate of performing a line officer's duty on board ship. Why not utilize him as he stands? Why not count him, when embarked, as a line officer, subject to all the service demands

made on line officers, with but this restriction, that his division be always the marine guard? His opportunities for technical improvement while afloat are adequate. It cannot be held that his duties ashore are less naval or military than those of junior officers who wind chronometers, paint lighthouses on charts, teach school and perform clerical work under another name. In case of epidemic, or other cause reducing the quota of watch officers, no captain, if the emergency were really serious, would hesitate to give a graduate charge of the deck, even if he did happen to hold a marine's commission. In this manner, and without injury to any one, we might reap substantial benefit and yet adhere to the general lines of the essay. I only make this suggestion as a *tertium quid* that should be discussed thoroughly before reaching any ultimate decision.

The present two years' probation for the cadet might be useful if the final examination were shaped to recognize and evaluate professional aptitude and officer-like qualities. As matters now are arranged these years are simply a waste of time. What the Navy wants is the best *officers* out of any class, not those youngsters whose chief recommendation is ability to score well in a theoretical examination.

If the Academy failed to supply enough officers to the naval service there might be reason in giving commissions to enlisted men who could pass the necessary examination. I can perceive no good ground for discharging the qualified graduate and at the same time promoting the seaman. That such a scheme would work hard to the body of enlisted men is shown in the old Sabine experience, where a few apprentices got into the naval school and the rest were disgruntled.

With the essayist's remarks on the necessity of placing more reliance upon the petty officer I am in entire accord. The petty officer is what we make him. I hope to see the day when he will be what his title implies, an officer with duties and responsibilities proportioned to his rate—and as valuable to the Navy as the non-commissioned officer is to the Army.

Similarly, the bluejacket will rise to the standard his officers set for him. If they expect him to get drunk and raise Cain on all occasions he will certainly get drunk and raise Cain. If they expect him to keep sober, dress well and act like a decent, reputable member of society, he will not greatly disappoint them. I speak from experience, but spare you the details.

What would you say of a ship's company of a hundred and sixty-odd men, exclusive of marines, in which all but about thirty had deposit accounts, some as high as $1000, and in which about $2000 a month were habitually deposited? Would not this ship's company be likely to prove a credit to the flag through the steadying effect on so many of its men caused by their having a tangible stake in the world? Such a ship there has been in our Navy. The crew, collected just as they came from the guards, an average lot, were brought to an excellent state of conduct and discipline by the simple means of cultivating their respect for themselves, encouraging habits of economy, elevating the better element, and

mercilessly crushing the "toughs" and blackguards, usually the leaders on board ship, but, in this case, a cowed and ridiculed minority. This result is everywhere within reach, but not to officers who fail to set a good example, whose travels on shore extend no further than the nearest billiard saloon or hotel bar, and whose salary, after defraying the expenses of these journeys, is inadequate to the maintenance of a proper wardrobe.

In many ways the improvement of the petty officer and bluejacket lies in our own hands and calls for no departmental or legislative action. When we shall have exhausted all the means at our disposal for lifting Jack up, then, and not before, it will be in order to ask help from higher authority; but what can we expect from others when we who live with him and know him best, whose duty it is to make him a better man and a more useful factor in naval efficiency, fail not only to discharge but even to recognize this obligation?

Lieutenant F. K. Hill, U. S. N.—The service at large is certainly indebted to Lieut. Fullam for his very modern article on the "needs of the ship." There seems nothing to criticise and only a few details to add to his very excellent article.

To do a given amount of work with a limited number of men it is more economical of the force in hand to divide the work equally among all the men, rather than give the lion's share of work to one set of men and the lion's share of leisure to another.

The character of the seaman class to-day is such that a seaman is perfectly capable of doing everything that a marine does, either on board ship or ashore, while the reverse is not true. This has been proved in many instances. On the Isthmus of Panama in 1885, at Bluefields in 1895, and during the late war in China, are a few of the instances in which the bluejacket performed, with marked success, duties supposed to belong peculiarly to the marine. At Seoul the bluejackets worked side by side with the marines and outdid them in reliability and fidelity. Everybody knows the marines have been landed many times. Who did their work on the ship when they were absent?

The marines cannot do seaman's work, and the proof of this lies in the fact that they have never had the temerity to propose it. Why, then, *have* the marines, who do practically none of the routine ship-work, and are altogether a drawback because they do not do their share of the work? The only excuse for their being is that they have been.

In former days the men of the seaman class were pressed into service from the merchant marine; they were rough characters, and a certain force was necessary to restrain them. The marines were introduced. In this country, now, it is different; a large and increasing number of our men are of the apprentice and continuous service classes, who choose their profession at an early age and pursue it with all the love and *esprit* of the true man-o'-war's man, and it is an injustice to place over them any but their own class of higher rate; while the marines themselves dislike their enforced police duty. In contrast, the majority of marines

(all except the drummers and buglers) enter the service at a later age, when they have usually tried something else and failed. Few re-enlist, because as landsmen they find their surroundings uncongenial; as a consequence we frequently see more than half the guard of a ship made up of recruits who are placed in responsible positions. At the present time (April 5, 1896) there are on the New York sixty-four (64) marines, fifty-three of whom are in their first enlistment.

Among officers the work is still more unevenly apportioned than among the men. Compare the work of a marine officer with that of a watch officer. Each has charge of about the same number of men, the drill hours for each are exactly the same, each is liable for certain court duty, but in addition the watch officer has $\frac{24}{5}$ hours a day of watch, is responsible for a certain part of the ship and battery, and is a member of certain boards, etc., from all of which the marine officer is exempted.

When, some years ago, Lieut. Fullam wrote an article proposing the abolishment of the marines on board ship he was opposed by many commanding officers; since then, however, such commanding officers as have had experience in solving problems of apportioning the largely increased amount of work necessary on a modern man-of-war have had cause to change their views.

The *raison d'être* for five designing engineers on board any of our ships is impossible to find. Is there in existence any great engineering plant with five designing engineers in charge of the motive machinery, no one of whom ever does any work with his hands? Suppose this great plant ran only fifteen per cent. of the time (one day a week), would these five engineers still be retained to direct the work of cleaning and keeping this machinery in good repair? This is what we have on a number of our vessels at present. Five vessels of the North Atlantic Squadron were at sea during the past fiscal year fifteen per cent. of the time. The New York has five commissioned and two cadet engineers.

What we need, as Lieut. Fullam says, is a set of first-class engine-drivers (warrant engineers) and two designing engineers on each ship, the latter to superintend and design changes and repairs. The first we have in our machinists; but instead of two designing engineers we have from three to five, and in addition cadets, who are sometimes given a watch in the engine-room. As a matter of fact our machinists actually can, and do sometimes, run the engines of our largest ships, as will be seen by the following case: A marine officer with no special mechanical training was transferred to the engineer corps and was almost immediately sent to the New York. He stood engine-room watch under the instructions of a senior engineer for 3 months, 29 days of which were steaming watches; he was then given entire charge and independent engine-room watch. Did he learn his business either as a designing or driving engineer in that time, or did the machinist under him run the engine while the officer took the responsibility?

The following tables explain themselves and show the proportion of work done by officers and leave granted to officers and men. The leave table for officers was computed from the official record in the admiral's

office on the U. S. F. S. New York, and that for the men from the "liberty book," embracing one month's time in New York, November 15th to December 15th, 1895.

The work done by officers is compiled from routine drills, and approximated in cases of courts and boards. The comparison is among the watch officers, the engineers that stand engine-room watch, and the marine officers of the U. S. F. S. New York.

AVERAGE HOURS WORK DAILY.

	Drill.	Watch.	Courts.	Boards.	Division.	Total.		%
Line,	2h.30m.	4h.20m.	30m.	30m.	30m.	8h.20m.		100
Marine,	2h.30m.	0.00	30m.	00	30m.	3h.30m.		42
Engineer,								
sea,	0.00	6h.00	30m.	30m.	30m.	7h.30m.	4h.30m.=54†	
port,	0.00	2h.30m.*	30m.	30m.	30m.	4h.00m.		

* The 2h. 30m. is obtained by allowing that the engineers on duty in port work 10 hours a day.

† The 4h. 30m. is obtained by taking 7h. 30m. for 15% of time and 4h. for 85% of time.

LEAVES (for officers).

Line, 100%. Staff, 179%. Marines, 367%. Engineers, 175%.

LEAVES (for men).

All but marines and band, 100%. Marines, 152%.

OFFICERS.

	Leaves.	Work.
Line,	100%	100%
Marines,	367	42
Engineers,	175	54

Lieutenant HARRY P. HUSE, U. S. N.—The effort being made in the Navy to reorganize the personnel meets with so much opposition in the Navy itself that the prospect of anything of any value being accomplished appears at times nearly hopeless. It is a fact, though it seems incredible, that in almost every discussion that is heard on the subject the claims and, as Lieut. Fullam aptly calls them, the "vested rights" of different classes of officers are brought forward as though the service were a piece of private property existing for the benefit of the officers. The fact that the Navy exists for the welfare and safety of the country and has absolutely no other *raison d'être* will be acknowledged by every one as an abstract principle. But in any scheme of reorganization where this principle is given precedence over the comfort and interests of any corps or class of officers, the cry is at once raised that great injustice is being done, and so far the cry has been successful in blocking all legislation.

But the country is becoming more and more interested in the Navy, and the time is probably not distant when thinking people will realize

that powerful ships without an efficient organization of the personnel do not constitute a powerful navy. When this day comes—and may it come before our next war, and not as a result of it—*vested rights* will play a small part in the consequent reorganization. In this reorganization, especially if it be after an unsuccessful war, where the interests of officers conflict with the efficiency of the Navy, those interests must and will be sacrificed. If injustice is done, due compensation should be made in some way that would not conflict with the best interests of the service as viewed from the standpoint of the highest efficiency, and from no other.

Lieut. Fullam discusses briefly the subject of the number of line officers necessary afloat. It seems to me that we are in a transitory stage in detailing officers to ships. For many years the requirements of the battery and the engines have been the guides in the assignments of crews; but in the assignment of officers the watch-bill alone is still consulted. The Indiana and the Castine have practically the same fighting force of officers. A captain, an executive, a navigator, and five watch officers, with an indefinite and constantly varying number of inexperienced junior officers, are assigned alike to a battle-ship of 11,000 tons and to a gunboat of 1000 tons. The English do very differently. They have fewer officers in their small ships and many more in their large ones.

I cannot agree with Lieut. Fullam about the paymaster and his clerk. Would it not be possible to turn over to the paymaster a great deal of the clerical work that is now done in the office of the executive, and thus relieve an officer who is overburdened, and add to the duties of one who would doubtless be glad to see those duties extended? Of course the clerk should be an assistant or cadet paymaster.

In our engine-rooms we want the class of men who run the engines of the great liners. On the larger ships there would naturally be a chief engineer and one or more assistants, according to the machinery and horse-power. But the watch duty should be performed by the class of men who handle just such engines in the Paris, the New York, and the many other magnificent steamers that carry a large portion of the commerce of our country. These men would be attracted to the service by warrants. In their examination no question of a scientific character should be allowed. We do not want college graduates looking forward to commissions and advancement; we want practical engine-drivers.

As to the marines, the question no longer exists afloat. So far as the sea-going officers are concerned there is now almost unanimity of opinion that the marine has no place on board ship. They have done good work afloat in the past, in the days of the press-gang and the cat-o'-nine-tails. To say now that their presence on board is necessary to quell insubordination and to enforce discipline is an insult to "the man behind the gun," who is better disciplined than the marine, more intelligent, and certainly more in touch and sympathy with his officers. Is it possible that any officer in command of a ship or of a division wants a marine to protect him against the insubordinate acts of his own men! If so, that officer is simply unfit to hold his commission. I once saw insubordination rampant on board. The ship was in dry dock, liquor

was adrift among the men, and perhaps one quarter of the crew were drunk. The corporal of the guard walked off in company with the sentry on the gangway and was joined by the sentry on the dock. The sentry over the brig disappeared with his prisoners, and doubtless all had a good time ashore together. It is fair to say that they left their arms and equipments to mark their posts.

We hear a great deal about the lack of initiative on the part of our petty officers. It would be surprising if under our present complicated system of discipline they did not hesitate to exert authority, the limits of which are so ill defined. Only consider the case of the forecastle of a single-decked cruiser. On board a vessel I have in mind that part of the ship is cared for by the port watch of the 1st and 2d divisions, and accordingly we should expect the petty officers in charge of those parts of the ship, one a boatswain's mate, second class, and the other a cox-swain, to be in authority there. But no! a master-at-arms, third class (junior to both), is held responsible for the discipline and condition of this part of the ship. And to add to the complication, the corporal of the guard must also keep his eye on what goes on there. Here are three people exercising conflicting authority. Is it strange that our petty officers lack initiative? Why should not the boatswain's mate of the gangway exercise full authority in all matters in the part of the ship over which he has supervision? We have made him merely a mouth-piece for the officer of the deck, and we occasionally direct him to take charge of hoisting a boat or something of the kind. But why should he not be in complete charge as to discipline and everything else in his own gangway? Let any commissioned officer of the line put himself in the place of any petty officer and answer frankly if he would assert himself any more forcibly under our present system than our men do now.

Warrants as rewards for meritorious services are an excellent incentive. A carpenter who is a skilled mechanic and knows thoroughly the ship to which he is attached is invaluable. If he lacks these qualifications he is useless and in the way. It would seem that a gunner should also be an accomplished mechanic, familiar with the construction of guns and carriages, and able to take the tools in his own hands and do any work beyond the ability of any of his gang. The position of warrant officer is assuredly good enough to put such men within our reach. There are a few in the service, but not many. Two years, or more if necessary, in the workshops at the Washington yard, on the pay of a seaman gunner, after the preliminary examination and before the issue of a warrant, would probably result in a gunner worth having on any ship.

Unfortunately the discussion of the reorganization of the personnel of the Navy necessarily involves an attack on our present system. I would wish to say nothing unkind or criticise any corps or class in an unfriendly spirit, but the very existence of the marine corps on board ship as a means towards discipline is a criticism most galling to the real fighting force, the "man behind the gun."

Ensign W. W. PHELPS, U. S. N.—The service is fortunate in having its attention so admirably called to a point from which reorganization can be viewed by a united front on the part of the line of the Navy. It must be that a vast majority of the line agree in the main with the reforms suggested in Lieut. Fullam's paper, and it is only necessary for officers to come out and say that they think so and the weight of the unanimous approval of the line must be irresistible.

Hump or no hump, officers can agree on ship reorganization; so-called personal rights are not tampered with, promotion and retirement have nothing to do with it, and we stand together aiming for the highest possible efficiency of the ship, the end for which we are always striving, but now with methods which, when viewed in the light of experience with our modern Navy, are clearly a drawback.

Discussion will of course result in settling the details of the needed reforms, but much can be done to bring out more prominently the self-reliance and appreciation of responsibility that characterize many of our best petty officers. There is no finer material in any navy in the world than that we have in our apprentices when they reach their majority, and as far as possible acting appointments to seaman branch rates should then be immediately conferred. The encouragement will be beneficial, and the feeling of responsibility and habit of controlling men will be instilled in youth.

The excellent discipline prevailing on the Dolphin is due in some degree to the system of day duty in port, carried on partly by reason of insufficient officers to keep port watches. The petty officers have unharassed control of their men, and the ship's work is carried on with admirable despatch. The petty officers feel the responsibility and their manhood comes to the front. It would therefore be a step in the right direction to extend this system to all the third-rate vessels and gunboats and reduce the number of watch officers.

That the era of usefulness of the marines afloat is past is so well recognized throughout the line, and the demand for seamen to replace them so urgent and so strongly felt, that captains, executives and watch officers alike must look forward to their withdrawal from ships as the greatest bound reorganization can take towards homogeneity of the crew and efficiency of the ship, and I am happy in the conviction that we shall see this important reform instituted at no very distant day.

Lieutenant J. M. ELLICOTT, U. S. N.—I feel it an honor to be permitted by the Institute to discuss this paper, for its subject is one of the important problems of the day; one upon which every live, thinking naval officer must entertain decided views, right or wrong; and those views upon which there is found the greatest consensus of opinion should be put to the proof of practice as soon as possible.

Even if the *matériel* of our Navy were increased to the utmost now contemplated by the most sanguine persons, "command rank young" could not be assured without overloading the command and executive grades. It is in the power of the Navy Department, however, to give

us the next best thing—a release from the more subordinate duties before middle life. If it were made the rule that an officer should not be required to serve more than six years (two cruises) as a watch and division officer unless further watch duty fell regularly to his lot within the first fifteen years of his commission service, officers would cease this duty short of forty years of age and would then be available as navigators, ordnance officers, executives of third-raters, commanders of torpedo-boats or special vessels, or for personal staff duty, and would thus escape the more subordinate duties at that crystallizing period of their lives which is to make or unmake them as naval commanders.

I agree with Lieutenant Fullam that the substitution of a lieutenant and an ensign for a paymaster and his clerk *on board ship* would be all clear gain in fighting efficiency. This is no reflection whatever upon the individuals of the pay corps nor upon its necessity as a corps. Its extensive duties on shore, which would be manifolded to an incalculable extent in time of war, would afford ample employment for its whole personnel; but no paymaster need be afloat, unless, perhaps, a fleet paymaster on the *personal* staff of flag officers. The billet on board ship would afford another opportunity for utilizing the lieutenant who had completed his six years' watch duty. It would be a wise proviso, however, that a line officer could only serve one cruise on such duty.

I largely disagree with the author regarding engineer officers on board ship. His arguments in favor of more line officers are just as applicable to engineer officers. The multiplying of engine-rooms, of fire-rooms and of auxiliary engines makes their supervision by one officer in battle as impossible as the supervision of the battery by the captain. It is as absolutely necessary to have the moral and military influence of an officer's presence in every engine-room and fire-room, and perhaps at every auxiliary, in time of battle, as it is to have it at the battery. What captain, if a steam-pipe were cut, a compartment flooded, or a rumor of sinking were spread below, would exchange the influence of the officer for that of the machinist to prevent panic in the emergency? In a closed fire-room, under extra atmospheric pressure and great fatigue, amid the demoralizing din of battle, would not the firemen more surely exert their greatest endeavor under the eye and encouragement of the officer? Would not the officer, with his military training, his high sense of duty and his understanding of the situation, be absolutely necessary? Should such duty be any less congenial to the engineer officer than the direction of the service of guns to a line officer? It is equally important, and the men under immediate command are just as numerous. Moreover, we should soon have poor designers if they did not get plenty of active and mechanical duty in engine-running. I believe that the lower grades of the engineer corps should be consideraby increased, while the chiefs are already sufficiently numerous. Engineer warrant officers would be excellent additions to the personnel, and would lessen the needed increase in the lower commissioned engineer grades. Above all things, however, the personnel of the engineer corps on board ship must be as absolutely under the direct command of the captain and

his representatives—the executive officer and the officer of the deck—as is the personnel of the line. On board of a large number of our men-of-war the chief engineer is in a higher grade than the executive officer, or holds a commission of older date in the same grade. This should never be permitted, for it causes a jealousy of control detrimental to discipline. No chief of command rank should be afloat, unless as a fleet engineer on a flag officer's personal staff. There is plenty of mere administrative duty for them on shore.

The marine corps is a body of trained troops mobilized at the seaboard under the direct control of the Navy Department. Its excellent usefulness has been demonstrated too repeatedly right down to the present day to need even a word of mention. Its existence is in no way jeopardized by withdrawing the marines from the ships. I do not believe that marine officers would oppose the experiment, and I believe that they would be perfectly satisfied if it proved successful. It is my further belief, however, that the withdrawal of the marines would be detrimental to our warships' efficiency. They constitute a guard which can be thrown ashore to protect consulates and other American property in foreign ports during periods of disturbance *without affecting the fighting efficiency of the ship they leave.* Their guard duty on board the ship is incidental to their presence there and gives them a natural and continuous employment, and they perform that duty exceedingly well. The very difference in uniform carries with it a moral effect upon blue-jackets which would be wholly lost if members of the latter branch were placed temporarily on guard over one another. The incessant training of the marine in sentry duty gives him an efficiency and a sense of responsibility for the maintenance of good order and discipline which the blue-jacket could hardly equal; not because the blue-jacket is at all inferior to the marine in capability for that particular duty, but because his training for it can only be a minor part of his general training, his practice of it would be more infrequent, and his intimate association with other blue-jackets would place him always at a disadvantage. The argument is that the withdrawal of the marines would give just so many additional men to the deck force, but it would not, in a working sense. There would be a guard detailed from the deck force daily, while the previous day's guard, needing rest, would be of little working value. Practically the same number of men would remain available for general duty as in the present condition. There would be a daily shuffling of gun captains, coxswains, helmsmen and men on minor details, both in port and at sea, because "so-and-so was in the guard." In action, of course, all but those actually on important posts would go to their guns, but it has been the experience of war that every man not in the powder division or engineers' force, be he marine or anything else, is, in action, available for the battery as its personnel is depleted. But argument upon this subject is wasted, for the proof is easy. Let the marines be withdrawn from the North Atlantic Squadron and their places filled with an equal number of blue-jackets. Leave the ships a year without marines, and, at the end of that time, call for reports upon

the subject; comparing for the same time the desertions, offenses committed, courts-martial, and the general fighting efficiency as shown by battle drills and target practice, with similar records for the preceding year. The question would then be settled once for all, and it is a question which should be settled without delay. The experience of a single ship for a few months is no proof and only aggravates the argument.

As for the marine officer, he is only found upon the larger vessels, where there are already five watch officers. If there were additional blue-jackets and no marine guard, would the marine officer be replaced by an additional line officer? The latter's *raison d'être* would be as a sixth watch officer, or as a drill officer and officer of the guard. Would he be allowed? Is it not more likely that those ships would have one officer less for general availability in action instead of one more? for the marine officer is a very available officer in battle.

I believe that the presence of the marine guard on board ship is decidedly conducive to efficiency at all times; that a separate, specially trained and distinctively uniformed organization in the midst of a ship's company is as necessary for the maintenance of order and discipline as is a uniformed police force in a city. Our endeavor should not be to cast out the marines, but to more thoroughly and properly utilize them. Give them a part of the battery, preferably superstructure, rail or bridge guns; they are trained marksmen. Give them a compartment to keep clean. They are not needed for coaling, for in modern ships with steam winches coaling can always be done faster than the bunkers can be trimmed, yet during coaling the marines are doubly needed as sentries.

I endorse most heartily every word said by the author upon the training of officers. I would add that instead of cruising in a sailing ship, even of the most efficient character, cadets at the Naval Academy should do their practice cruising in two modern, light draught, third rate cruisers having the usual auxiliary sail power and the latest approved weapons. On such cruisers engineer cadets and 2d classmen should do engine and fire-room duty, 3d and 4th classmen should do the duties of the seamen branch, while the 1st classmen should fill the billets of petty officers and, in rotational details, perform the duties of watch and division officers, and should work the navigation incidental to the cruise. A leaven of seasoned enlisted men on deck and in the fire-rooms should complete the complement. These two ships should coast in squadron as far north as the St. Lawrence, entering ports frequently and passing through all available coastwise channels. Their stops in port should be extremely short except when matters of professional interest detained them. Squadron evolutions, battle drills and piloting should be assiduously taught, and gun and torpedo practice held at least once each month, or three times during a summer cruise.

I have served on two cruisers of our new Navy, and have been in four squadrons of new cruisers. In all of these the schemes which Lieutenant Fullam suggests for the improvement of the petty officer and the blue-jacket were being so successfully applied that I believed the time had passed for any exhortation upon the subject. My experience has been

that the blue-jacket on shore readily learns to be a soldier and takes pride in military duty; that the petty officer controls his squad or section with intelligence and firmness, and I do not think that adding sentry duty to their other duties afloat is necessary to make them efficient soldiers ashore, whereas, if they are properly drilled in company drills and landing parties, they will not be found wanting *should an emergency arise* requiring them to do sentry duty afloat.

Lieutenant BRADLEY A. FISKE, U. S. N.—I am strongly in favor of the withdrawal of marines from our modern warships. My reasons are exactly those stated by Lieutenant Fullam.

Lieut.-Comdr. RICHARD WAINWRIGHT, U. S. N.—In attempting to discuss Lieutenant Fullam's paper I have met with the same difficulty that has been encountered by many others, I imagine, who, finding the subject so well treated and agreeing thoroughly with the main conclusions, are both unable and unwilling to criticise, and yet believe the paper to be too important to be allowed to pass unnoticed.

No one can dispute the fact that the personnel should be so organized as to best promote the fighting efficiency of the ship and of the fleet, and that, if necessary, the rights of the Government must prevail over "vested rights." Still it would be better for all, and would tend certainly to aid in reorganization, if no "vested rights" were disturbed.

For the engineer corps, I think they are mistaken in advocating increased numbers and increased duties. No one has more reason to be proud of his work in forming the new Navy than the naval engineer. Why should a corps that is capable of designing and constructing engines, and has been so successful, desire to drive them also, and, worse still, be forced to stand cold iron watches and make tidal observations in the bilge? Are not their present successes largely due to the fact that, because of the many new ships built and building, they have been forced into designing, constructing and superintending, leaving the engine-driving to the machinists? It seems to me that their influence and position will be stronger and the Government's work better done if the corps be composed of comparatively few commissioned officers devoted to designing, constructing and superintending, with a large number of warrant officers to drive the engines, than if it be composed of a large number of commissioned officers who combine the duties of both the trade and the profession.

Also as to the marine corps, they are no longer necessary on board ship as policemen or as small-arms men, so they wish to undertake to fight the guns and to coal ship. The training of seamen and of marines differs greatly; either the men at the guns should be all marines or all seamen; the men of inferior training must go. The officers who are to fight the ships know that seamen are best fitted to fight the guns.

Historically, the marine antedates the sailor in the Navy. His record in war or peace is second to none; his appeal for maintaining his "vested rights" is strong and will receive recognition even in face of

service requirements. How can they be served better than if held as an expeditionary force organized as a skeleton brigade? They may not go on the sea so often, and they may be relieved of some of the duties of watchmen at the navy-yards, but they will be able to keep up their old-time efficiency and will have logical reasons for their existence. Nothing is more expensive than an expeditionary force made up from men carried on regular men-of-war where it requires many vessels to give as large a force as can be carried on one transport. Landing parties for the protection of a consulate or for visiting punishment upon some barbarous tribe, where the ships are close at hand, are most necessary; but if a real expedition is to be undertaken, either requiring a comparatively large force or to go to a distance from the ships, marines would be more effective and less expensive. As our interests increase and our commerce extends, such a force will be required sufficiently often to prove its value, and, when real war comes, who can question the necessity for marines to defend naval bases?

I believe the medical corps of the Navy should have charge of the Marine Hospital Service, and that sea duty, being distributed among so many, should form only an incident in the career of a medical officer. In time of war we would then have a large corps of trained officers to take charge of the hospital ships and temporary hospitals at the various bases, as well as the permanent hospitals. During both war and peace they would take on board ship apothecaries and nurses trained in their own schools. Think what a splendid corps this would be for war or peace, particularly if organized and controlled by the present energetic Surgeon-General of the Navy.

The Bureau of Supplies and Accounts is rapidly centralizing the purchase and inspection of all supplies and the control of all accounts. Officers with a thorough business education are necessary at navy-yards and stations, and in time of war to visit various sources of supplies, to complete large purchases and to distribute the supplies from the several bases. One officer of experience is necessary to make purchases and supervise the accounts of each fleet, but the small amount of such work required on a cruising vessel could be performed by an officer trained to fight the ship. There are only four officers in the pay corps not actively employed—one on leave of absence, one waiting orders, one settling accounts, and one on sick leave. Those now on board ship would be required, in time of war, for more exacting duties on shore, and might be stationed there now, where they can become intimately acquainted with the business of purchase and inspection as well as that of accounts.

With the personnel of the Navy thus organized, there would be little room for conflict of authority or struggle for precedence, and on board ship all officers, except the superintending engineer and the medical officer, would be trained to fight the guns and to handle the vessels. The interests of no corps would be injured in the reorganization, and the Government would be greatly benefited by the increased efficiency of the naval service.

Lieutenant A. P. NIBLACK, U. S. N.—Lieutenant Fullam's essay is vigorous, healthy, incisive and convincing. That it did not get the prize must be regretted by all who read it, as the subject is a vital one and the method of treatment most able. As stated in the essay, a perfect military system would require that every officer on board ship should be available for any service in connection with its offensive power. A very desirable approximation to this in our Navy would at least seem to demand that all the officers, regardless of the departments they are in, should be interested in, or at least not hostile to, all things military.

The installation of the commanding officer on board ship as the supreme mechanical and automatic weapon, and the furnishing of him with the proper facilities for executing the enormous trust placed, necessarily so, completely in his hands, is at the very root of all questions of organization and discipline. The delegation of part of this authority to the executive officer as his representative is as much a military necessity as the giving of it at all to the commanding officer. The effort to evade this and to belittle the position of the executive wantonly strikes at the very root of all military organization. Shall the authority on board ship be parceled out to various departments, as contemplated in class legislation now pending in Congress? It seems almost in order to ask shall we hereafter elect commanding officers by ballot.

The prospect of a marine officer as a regular watch and divisional officer; or of a line officer commanding marines, or acting as paymaster or chaplain, or standing an engine-room watch; or of an engineer commanding a ship; or of everybody being called lieutenant, or commander, or captain, or admiral, is not a thing to get stampeded over, provided each officer in each position understands the job and has the military spirit. Put any officer on the bridge of a ship from any corps and he will find that he cannot run the ship successfully unless everybody on board occupies just the relation towards him as all do now towards the captain and executive. One does not become a line officer simply by walking up and down the bridge with a trumpet in his hand. Back of him is an intricate profession, alongside of which the purely technical ones are simply specialties. It does not vitiate the argument to say that some of the line officers are not up to the mark professionally.

The duties of all staff officers on board ship can be taken by civilians of *special* talent after a few months' training, principally of a military character. Highly scientific doctors are not nearly so important as that what few we have shall be subordinate and shall have the military spirit. As all officers and men are above the normal as to physique, why make the entrance and other examinations so high for the medical corps that the corps cannot be kept recruited up to its full number? The Medical Corps as a body may be interested in keeping its standard up to the highest. The interest of the Navy as a fighting organization is rather the other way. The very smartest and brainiest doctors feel that they can do better in civil life, and certainly the practice on board ship is not calculated to keep a man in the front rank of his profession as compared with practice on shore. A contented doctor, with talents

commensurate with the pay he gets and work he does, ought to be good enough for our Navy. The record of our Engineer Corps in the design of modern marine engines and boilers is one of unbroken success. Nothing in our Navy is deserving of more credit or of greater recognition, yet when this machinery and the boilers are installed in a ship and satisfactorily tested, is it demanded by common sense that the young officers and others who put their brains into this work shall go to sea and stand a machinist's watch? Must a chronometer-maker cruise with his instruments to keep them going, or is it simply a question of *intelligent* care and supervision? While on the one hand the Medical Corps tries to be too select from a military standpoint, the Engineer Corps is dead-set the other way. The marines are the ones who really have a grievance. In all other countries save Great Britain, the sea-coast defenses are in the hands of or controlled by the naval establishment, as common sense and reason dictate should be the case in ours; but even in Great Britain they draw some of their marines for service afloat from the marine artillery. Our Marine Corps is in a very unfortunate position. It has not men enough to properly carry on guard duty on shore, and to increase the corps is to agree to a perpetuation of existing conditions. For my part I believe Lieut. Fullam to be absolutely and thoroughly right; but if the authorities decide otherwise, then in the name of reason let them go to the batteries, man the guns, clean ship and become a part of the ship's working force. A modern officer or blue-jacket must be a good deal of an engineer, marine and sailor combined. It would seem the part of real wisdom to draw on the artillery of the army for marine duty on board ship if we are to have the present system. Section 1619 of the Revised Statutes says, "The Marine Corps shall be liable to do duty in the forts and garrisons of the United States, on the sea-coast, or on any other duty on shore, as the President, at his discretion, may direct." It would be a happy solution of part of the difficulties and give real meaning to the service of marines afloat, to detail marines for sea-coast defenses and send the artillery to sea for awhile. Why not?

Most of the trouble in the Navy personnel is unavoidably due to the fact that we are all restless under the revolution in the profession in the last ten years or so. Our present organization is in many ways a misfit, we have somewhat outgrown it. Personally, I would be particularly glad to see the Engineer Corps have supervision of the entire question of all mechanical construction (including guns and gun-mounts) and of all auxiliary machinery on board ship, and I would be very glad to see the Marine Corps in charge of the sea-coast defenses, and, for educational purposes, on board ship (not as now as ship's police). Line officers are artillerists, tacticians, sailors, sea-goers, and to them should be given command at a reasonable age and, practically, constant sea duty. There are a number of officers in all corps mentally too old, or too unadaptable, or too disillusioned or soured by unfortunate experiences, or too imbued with the traditions of the past, or too relatively inexperienced at sea compared with officers many years and many grades

their juniors (see Navy Register), or too out of touch with anything but shore duty, to even agree on any measure which contemplates a reorganization. Irrespective of corps, those who have the military spirit and are not over-due for sea are in touch to-day. The discord and bitterness are personal and selfish. Whether or not any reorganization does take place, the Navy is steadily getting better every day, and every one is becoming more efficient. Officers cannot serve in the newer types of ships without knowing their business, particularly with a live flag officer on deck.

Lieutenant Fullam has done a great service to the Navy.

Lieutenant G. B. HARBER, U. S. N.—I have read the essay of Lieutenant Fullam on "The Organization, Training and Discipline of the Navy Personnel as Viewed from the Ship" with great pleasure and interest. It expresses with clearness and force, greater than I had done to myself, many views which I have long held, and some to which I am a recent convert.

I do not wish to discuss the essay at length, but while there are minor points to which I do not assent, I desire to express my hearty approval of the point of view chosen by the essayist, and of the essay as a whole.

Lieutenant ALBERT GLEAVES, U. S. N.—I have served in two ships without marines, and my opinion is that the Navy is approaching the stage in its development when their places can be supplied with advantage to the service by blue-jackets. The drift is inevitably in this direction. On the Monadnock the blue-jacket performs the duty of orderly, sentry and corporal of the guard—

"'E's a sort of a giddy hermaphrodite, soldier and sailor too"—

and it is a pleasure to testify to his trustworthiness and zeal.

In regard to permanent ratings, they should be restricted by such cast-iron qualifications, and the same remark applies to continuous service certificates, that only the most deserving can ever get them. I have recently been shipmate with four "permanent" quartermasters; none of them could read signals, and at least two spoke such broken English as to be almost unintelligible. The Department's order concerning the rates of coxswains and quartermasters is a long step in the direction of making permanency in rating very desirable.

1st Lieutenant CHARLES A. DOYEN, U. S. Marine Corps.—The writer of this article would approach with diffidence and caution an essay on the above-mentioned subject if it did not involve a discussion of the advisability of dispensing with marines on board men-of-war in our Navy; but as his own experience and opportunity for observation have been nearly, if not quite, equal to those of the essayist, and his knowledge of the duties and capabilities of the Marine Corps is certainly greater, he feels that he can with some degree of confidence comment on the portions referring to that corps.

The essayist advocates dispensing with paymasters and marine officers entirely, and reducing the number of engineers, their places being filled by line officers. Now, while convinced that the line of the Navy is, and ever must be, its backbone, the writer ventures the opinion that the other branches can only be dispensed with at a great sacrifice of efficiency and economy. The efforts of a few line officers to assume the duties of officers of other branches would almost cause one to think that, under existing conditions in our service, they are so numerous, or find their own particular duties so light, they must enlarge their sphere of labor to show some cause for not having their number reduced. Their duties are, however, as a matter of fact, second to none in importance, and if conscientiously performed, and an officer keeps up to date in the details of his own branch, he will have little time or inclination to master the details of others. It is suggested that any such organization as the one proposed would result in the raising up of a type of naval officer indifferent in all the branches of his profession and master of none. As an army needs, for a successful campaign, all the various branches, engineers, artillery, cavalry, infantry, quartermasters, commissary, medical, etc., so men-of-war, for greatest efficiency in war or peace, need all the branches now on board ships.

We are living in an age of specialists, and all-around workmen cannot compete with specialists in their own particular branch.

There is something sublime in the way the essayist waives aside the lessons taught by centuries of experience and observation in foreign navies, when he says, "No matter what may be the custom in foreign navies, this question should be considered from the standpoint of the greatest good to the greatest number," etc. In other words, don't let us profit by or pay any attention to the conclusions arrived at by others; their years, yes, centuries, of experience and observation are as nothing compared to our untried theories. Comment is unnecessary.

The essayist says, "The few duties now performed by marine officers afloat could be assigned to line officers, who would also be available for all other naval work." This is, in a measure, true, but would these duties be any more efficiently performed? Are not about 62 per cent of the line officers of the Marine Corps now graduates of the Naval Academy, equally competent with line officers of the Navy of their date to perform "all other naval work"?—perhaps not quite as well, owing to lack of practice, but still satisfactorily, and they certainly are of more value in operations on shore, which are not the least important of the duties that fall to a navy in time of peace or war.

The writer takes exception to the essayist's statement that line officers of the Navy have a military training. Where do they get it? Certainly not at the Naval Academy, where they are given the merest instruction in the "manual of arms" and a few simple company and battalion movements, these from a drill regulation book which was compiled by naval officers and was no sooner issued than it was followed by a volume of corrections and additions, and is now soon to be discarded. Military training comprises among other things practical and theoretical instruc-

tion in the principles of "strategy," "minor tactics," "fire discipline," "field engineering," "military topography" and kindred subjects. Drill regulations are the ABC of military training, and, principally, the means of perfecting discipline. Marine officers are now instructed in all these subjects and are required to pass rigid examinations in them before promotion; therefore, being graduates of the Naval Academy, and having some military training, may they not, without presumption, claim to be as competent and available for "all-around work" as line officers?

Again the essayist says, "When naval forces are landed for service on shore a line officer is usually in command, especially if the force is large and the duty correspondingly important." Are we to infer from this that marine officers are less competent for this duty? That a marine officer should command mixed detachments on shore is eminently proper and contemplated by Regulations, which place the marines on the right of the line in military formations, and assign to command the force the senior in rank, be he a line or marine officer. From the nature of the organization of the Marine Corps, however, and the fact that the highest rank of officers afloat is that of captain, corresponding to lieutenant in the Navy, it is practically impossible for any landing party of size and importance not to contain many line officers senior in rank to the marine officer; and in naval shore operations, not originating in a fleet, care is taken by the naval authorities to detail a line officer senior in rank to any available marine officer, even though the marines outnumber the sailors four to one. Why this is done needs no explanation here, but I do not fear contradiction when I assert that 'tis not because marine officers are incompetent to command.

It would seem that the essayist realizes the importance of having on board ship a body of well-disciplined men whose specialty is operating on shore, as he says, "It is unfortunate that some officers are inclined to deny the importance of landing forces. When we consider how frequently our men have been called upon to land in all parts of the world, it would be reasonable to say that a naval officer *is quite as apt to be called upon for active service with men under arms on shore* as with the ship's battery at sea. It follows that officers must prepare themselves for this important practical work, and must not glory in the fact that they know or care nothing about it." But he fails to fully grasp the importance of it when he says, "A simple drill book and a simple manual are needed, that is all."

Again we read, "In the recent landing drills of the North Atlantic Squadron, line officers who had never before had an opportunity to witness or practice the new 'extended order' grasped the subject at once and handled the blue-jacket battalions in a manner that showed a peculiarly intelligent conception of all the practical points involved. The onlooker could not fail to see that the line officer is equal to all military duties, and that the infantry part brings the least strain on his intellect." This would depend somewhat on the onlooker's knowledge of the subject and his ability to judge, but having participated in many

such drills I can easily understand that no intellect could be strained by acquiring the amount of military knowledge displayed on that drill ground.

The merest tyro in military knowledge can shout orders from the drill-book and march a battalion around a field, but when it comes to handling troops in the presence of an enemy I submit the statement that the average line officer, in making a judicious selection of ground, preparing it hastily for defense, disposing of his forces to the best advantage, providing for the security and information of the whole, would be as much at sea as the essayist is when he states, after a dissertation telling us how simple it is for a sailor to become a soldier, and how difficult the reverse: "The assertion is ventured that there has never been a system of infantry tactics which requires on the part of men so high a state of discipline, so high an average of personal intelligence and such quick, united action as was demanded of seamen in the spar and sail drills on board a well-drilled ship, 'Fours right' and 'Charge bayonets' being less strain on a man physically and mentally than to pass an earring or furl a topgallant sail." The essayist evidently means "Infantry Drill Regulations," not "Infantry Tactics"; there is considerable difference, and I take it for granted that his essay deals, not with the conditions existing in the old Navy, but the new, and modern men-of-war's men on cruisers, battleships and coast-defense vessels don't pass many earrings or furl many topgallant sails.

The statement of the essayist that "a general commanding an army properly decides, if anybody can, how much infantry, cavalry and artillery are needed to conduct a campaign," taken in connection with his proposition to make a ship's company "homogeneous," gives rise to the query: Why not have a "homogeneous" army composed entirely of infantry and uniformed exactly alike, who, in times of peace, could be drilled and instructed as artillery, cavalry and infantry? Then in action they could first, as artillery, shell the enemy, then as infantry move forward to the assault, a portion mounting horses when it comes time to charge the demoralized enemy.

The assertion is continually made in the essay that marines afloat prevent the development of the sailor; this is not so. Nobody is or can be responsible for the development or non-development of the sailor but his officers and himself; the matter rests solely in themselves. There is no law or regulation to prevent sailors from performing sentry duty or being orderlies to commanding officers, for purposes of instruction or otherwise; instruct them in guard duty; give them military instead of naval training if that would better meet the requirements of the Navy, but don't begin by dispensing with marines, the only military body in it, and then attempt to bring sailors up to their military standard, for, from the very nature of attending circumstances, a good sailor would be spoiled in making a poor marine. As the essayist elsewhere suggests, encourage sailors to be self-respecting and trustworthy by putting responsibility on them and trusting them; give petty officers charges of squads or guns, etc., at drills; put him in charge of a boat or a working

party without an officer to watch him, but don't put the onus of poorly trained, unreliable petty officers and sailors (if they are so) on marines. 'Tis a poor subterfuge, as unkind as it is unjust.

"The possibility of teaching the blue-jacket *all it is necessary* for him to know about soldiering" is conceded, and undoubtedly the more he knows within certain limits the better man-of-war's man he will be. In this connection Admiral Colomb's remarks complimenting the English blue-jacket on his steadiness, reliability and daring in campaigns on shore, also on his loyalty and discipline, which remarks are "full of significance" and "merit study," it might be interesting to know if there is any disposition in the English Navy, which undoubtedly has the best trained seamen in the world, to replace marines with blue-jackets No! On the contrary, English naval authorities and commanders, after years of experience, with matured judgment, advocate increasing the number of marines, and, like Admiral Colomb, hold them up as models of "loyalty and discipline," speaking in almost unqualified terms of their utility and efficiency.

Under the subheading "Ship Work and Conditions Afloat" is found this statement: "Nothing so seriously threatens the *esprit* of the men, nothing is so discouraging and demoralizing to them, as to neglect to reduce the number of idlers afloat." From this and what follows the inference is that the essayist considers marines on board ship as idlers. An idler in sea parlance is any person on board ship who doesn't stand a regular watch. Marines afloat, with perhaps the single exception of quartermasters, stand more hours regular watch than any other class in the Navy. In port and at sea, day and night, week after week, year after year, they stand watch as sentinels over life-buoys, gangways, prisoners and cabin-doors, generally having two hours on post and six off; in addition thereto, those not on post are instructed and exercised at all prescribed drills, keep their part of the ship clean, and are subject to the orders of the officer-of-the-deck the same as the rest of the crew. On the cruisers without sails, and battleships, which spend a large portion of the time in port, sailors have comparatively unbroken rest, only an anchor watch (about five men who sleep most of the time) being kept on deck; even at sea they stand in "quarter watches," giving them three out of four nights in. Ships are not coaled, scraped or painted every day or week and often not once in two months, so the seaman, who has had practically unbroken rest between times, with barely enough drill and routine work to keep him from growling, is amply able to handle the coal shovel and basket, scraper or paint brush, for a couple of days without any great physical strain.

The working force on board ships to-day *is ridiculously small* in proportion to the size of the crew; there it no doubt about it; and here again the essayist puts the fault of a poor organization on the marines. There is a large class of "idlers" who don't assist in coaling or scraping ship, such as stewards, cooks, servants, bay-men, etc., and there is another class even larger, many of whom are always, for some undiscovered reason, excused—I mean petty officers. The ships of our Navy

are full of them. They compose about one-third of the total strength of the line enlisted force; a seaman can hardly escape the honor of being one. As an example, the Baltimore had 37 petty officers and 112 seamen, ordinary seamen, apprentices and landsmen. In the old Navy petty officers were "leading men," the first aloft at sail or spar drill, and they set the pace and example at "all hands" work. The working force now would be more materially increased if they were still "leading men" than it will be by dispensing with marines. In the instance cited by the essayist, when, out of a complement of 300 men, 30 of whom were marines (how quickly they were singled out), there were only 67 men available for a working force. What were the remaining 203 doing? I will be more just with his instance than he is with the marines and assume that some 85 men of the engineer's division were below at work; we now have 118 to account for; 50 more is a liberal allowance for ship's police, quartermasters, electricians, stewards, cooks, servants and all others who have the faintest reason for not working under such circumstances. Now will the essayist account for the remaining 68 men and show why 15 marines, with a long record of broken rest and sentry duty, in addition to the usual routine work and drills, should coal or scrape ship while some 68 "all-around working men" are not assisting? If all the men whose legitimate duty it is were required to coal ship, it would not be necessary to call on marines except in cases of emergency, when they are always willing and available. The essayist is very unjust and unfair towards the marines, either through personal prejudice or ignorance of the nature and amount of their duty, perhaps both, or he would not indulge in sarcasm in a perverted quotation. When, after making a great point of 30 marines and no point of 203 others in the complement, he says: "And yet we are told that the *marines* are so overworked that *the limit of human endurance has been reached.*" He is told the truth, for the quotation is from the report of the commandant of the Marine Corps, referring to the scarcity of men at shore stations, where the men are continually on guard or other duty 28 hours out of 48.

One might never realize the vast superiority of the sailor's receptive ability and intelligence over the soldier's until he reads statements to the effect that "the blue-jacket is easily taught the soldier's drill," the one thing he knows, but "a soldier cannot be so easily taught the hundred things a sailor must know." The sailor can master a soldier's simple profession in a few weeks, but the soldier cannot master the sailor's complex and intricate one; that while this phenomenon the essayist has created in his mind easily acquires proficiency in military training, the marine "would not be efficient at work on stages over the side" (handling a paint brush or scraper, it is presumed). Truly, here is cause for profound thought and reflection. In spite of the essayist's prediction to the contrary, it is an established fact that on the battleships, with their increased force of marines, they do assist in coaling and other "all hands" work. By Navy regulations they are required to be exercised in pulling boats, so by assigning them to a boat by

themselves to avoid mixed uniforms they can do "their fair share of work in boats."

Perhaps the most important reasons for having marines on men-of-war are:

1st. In time of action they form a division in the detail of the whole force for battle and are equally competent with sailors to man the guns of the main and secondary batteries, and form a most efficient body of sharpshooters when necessary.

2d. When it is necessary in peace or war to land forces to maintain our country's dignity and honor abroad, the marines, on account of their superior military training and discipline, become necessary as an example of steadiness and a rallying point in case of a temporary break or disaster. Naval history substantiates these statements.

In the essay I fail to see any sound arguments, substantiated by facts, for taking marines from ships. The essayist has tried to show, 1st, That marines are idlers, when, as a matter of fact, they are to-day doing much the same work as sailors, in addition to guard duty. 2d, That their presence as sentries is a reflection on the sailor's manhood and reliability and prevents his development, yet he advocates replacing marine sentries with sailor sentries. Are there degrees of reflection depending on uniforms? As a matter of fact, marines don't stand as sentries over sailors any more than they do over marines, and a sentry's presence, sailor or marine, is no reflection or additional restraint on self-respecting, reliable men. 3d, That at "all hands" work sentries are not needed; take them off, thus increasing the working force, and "station and employ petty officers in a manner to prevent the possibility of an infraction of regulations." This would give an ordinary man in the working force at the expense of a leading man, and the sailor's reliability would still be reflected on. Experience, the best of teachers and guides for future moves, has shown marines to have ever been a most useful and efficient body on board ships, and we cannot afford to experiment with pet theories of officers which are directly opposed to teachings of years of experience and observation.

I cannot conceive who compose this "large majority of line officers" whose sentiments this essay voices (they must be mostly junior officers and those who have never had the responsibility of commanding a man-of-war), for within about two years some 60 letters have been filed at the headquarters of the Marine Corps; letters written by officers of experience and command rank from the grade of rear-admiral to commander, advocating the retaining of marines on board ship.

The marines have reflected credit on our Navy both afloat and ashore from its birth; their name has ever been synonymous with faithful and efficient service; they have 19 times received the thanks of Congress for gallant and meritorious conduct in battle, and their valuable services at Formosa, Corea, Alexandria, Egypt, Panama, Samoa, Hawaii, China and elsewhere, where they have been landed for service, do not need recapitulation here.

As for economy, I will simply state that to replace the 1000 marines

now at sea with 1000 sailors of the corresponding grade would increase the yearly appropriation to pay the Navy by $69,584.16.

The sailor can never, from the nature of circumstances, organization, training, etc., replace the marine when a force is to be landed; his duties are most important in his own branch, and he, like the marine, requires special training. Neither can replace the other; both are essential for efficiency, each supplementing the other and making a perfect whole.

The following is an extract from the last annual report of the Secretary of the Navy:

"There has always been more or less objection on the part of some officers of the Navy to marines on board ship, but as marines have constituted a part of our naval establishment both on shore and afloat from its infancy, it may fairly be presumed that experience has, in the opinion of those who control, demonstrated the wisdom of maintaining this branch of the service. The Department has recently had occasion to consider carefully whether, under the conditions at present existing in the Navy, is was for the interest of the service to depart from the long-established custom and entirely dispense with all marines on battleships. The modern battleship is largely a floating fort. It remains, as indeed all naval vessels under steam alone must for much the greater portion of the time, in port, where it exercises its crew in landing parties and infantry drills far more than was permissible when ships were for long periods at sea. These drills on shore and afloat, together with the handling and firing of great and rapid-fire guns, constitute also a much larger proportion of the actual experiences of the modern sailor than of the old-time tar, who was much of his time occupied in performing the duties peculiar to sailing vessels, and it is expressly in infantry and gun drills that the marine is or may be an expert.

"It would, therefore, seem that there is far more propriety in having the ship's crew composed in part of marines now than there could have been in the days of the sailing ship. No reason appears why marines should not man a portion of the guns on board ship as well as handle small arms, nor is it perceived why their officers cannot, subject to the orders of the captain, command gun crews, and even gun divisions. The fact that marines are enlisted for five years, while sailors are only enlisted for three, is clearly an argument in favor of retaining the marines; and the having on board of two different organizations, if a proper spirit of rivalry between the two is encouraged, ought to be considered another advantage, especially in cases of insubordination. For these and for other reasons the Department decided to put sixty marines and two marine officers on board the Indiana, and it will put marines on the other battleships as they are severally commissioned."

In conclusion, the writer ventures the opinion that the essay points out many needed reforms, in the correction of which the essayist and his supporters could more profitably expend their energies and abilities than in trying to assume duties which can be more efficiently performed by those specially trained for the purpose. Their energies and abilities should be directed toward encouraging a spirit of friendly rivalry and

competition, toward making a harmonious rather than homogeneous whole, instead of toward stirring up strife and dissension by unjust reflections and comments without foundation in facts. Homogeneity, as advocated in the Navy, is a snare and delusion, and, I believe, simply a cloak for selfish motives; it would destroy competition, the vital spark of progress.

Lieutenant C. S. Richman, U. S. N.—I have been requested to make suggestions and criticisms in this instance. To that end I have to say that my experience in practice leads me to approve generally the arguments as set forth in the essay; however, there are two or three points that might be elaborated even still further, viz., I believe in the "man behind the gun" and the man that can direct men (you want sailors on dark nights); plenty of *competent* men to handle the lock-string, or, to be more modern, "electric primer." The combatant force should be as large both in officers and men as the accommodations will allow. As to the marines, while I have always admired them, the object for which they were designed on shipboard is obsolete. In my position as navigator of the Raleigh it has often been apparent to me that although the Regulations require me to handle the ship as officer-of-the-deck *in action*, I have not even a messenger to assist me at general quarters. True, there are thirty marines, but they are a separate organization and command. Thirty blue-jackets in their place could man a boat and form a crew to take charge of and take in a prize; now it cannot be done on this ship without disabling an entire division.

The suggestions as to the War College are timely, and, to my mind, worthy of especial consideration; also the suggestions as to the warrant officers and the responsibility that should be given to petty officers and enlisted men. I have had occasion to note the large number of apprentices who do not serve out their enlistments, or having served their time, fail to re-enlist. There is doubtless a good reason for this, viz., a boy of 21 years or less is not satisfied with three months at home; he passes the day to re-enlist, then seeks employment, but in a few months would return if it were not that he loses privileges—comes in as a tramp and goes to the bottom and commences all over again because he has no *trade* except that of a *seaman*. On the other hand, a man with a trade can enlist as a landsman and get a rate. Still, between 17 and 21, the very time that the same landsman might enlist and in that time learn any trade on board ship, and, incidentally, become a seaman, is barred. Referring to the men and their messing and the remarks generally in that connection, I agree heartily with the essayist, but take occasion to call attention to a previous paper (published by the Institute) from the pen of Lieutenant-Commander Delehanty, U. S. N., which covered the whole ground. I was personally witness to the successful workings of the method he described, and only regret that in that matter he was as much in advance of the times as the new Navy, with new methods, is now behind his suggestions of years ago. The ships to come should have one mess for the men, one steward, one bill,

etc., but the steward and cook must be considered in the design of the ship and appropriate accommodations provided. *The mess chest must go.*

Lieutenant C. E. COLAHAN, U. S. N.—I have read with great interest the valuable essay of Lieutenant W. F. Fullam, and were most of his ideas carried out, the Navy, I am sure, would be greatly benefited.

As our service increases, and increasing it certainly is, the number of line officers must be likewise increased, though it is my opinion that some of the smaller vessels do not need as many line officers as they now have—I speak of the gunboat class—two might be withdrawn from nearly all of them, the warrant officer taking their places. The petty officer, trusted as he should be, and given a position of more responsibility, could relieve the line officer of many duties. I believe the pay officers should remain as they are, but it is suggested that appointments should be made from the graduates of the Naval Academy, and that in addition to their ordinary duties as pay officers they should always be officers of the powder division, and that their examination for promotion should have their fitness for the performance of this duty in view.

The warranted class of officers should be increased and extended to the engineer branch of the service, which would do away with the demand for an increase in the number of commissioned officers in that branch.

I am a thorough believer in the necessity of educating officers in piloting and in the practical study of the features of our coast; it cannot fail to be of inestimable value to them, and I am quite in accord with what this essayist says on this subject. The blue-jacket is not trusted sufficiently. I think officers should be a little more generous in the matter of liberty and not keep such a tight hold upon the purse-strings of the enlisted man, provided he has a sufficient balance to keep him in excellent condition as regards clothing, mess account, etc.; the enlisted man earns all the money he gets and has a right to spend it. Thriftiness should of course be encouraged. In regard to the question as to whether the marines should be continued in service afloat or not, it is simply necessary to consider whether it would be for the benefit of the ship to retain on board a number of her people whose duties are circumscribed, or to replace them with those who could be called upon for all duties; it is not a question as to whether the line officer and his men can perform certain duties as well as or better than the marine officer and his men; they are persons of precisely the same degree of intelligence and the same may be expected of both.

The marine officer, graduate of the Naval Academy, may be perfectly competent to take upon himself all the duties of the line officer. Well and good; let him be made a line officer. His men, however, are not, from their training, capable of doing all the duties of the seaman, and this is the reason that, in my opinion, they have no place on board ship. I hold that it cannot be expected to require the Navy to be proficient in the higher features of tactics on shore, nor will it ever be required of it. The Indiana would be far better off as a ship if her sixty marines

were replaced by men of the seaman class. All boys of our country are eligible for appointment to the Naval Academy, and I am of the opinion that no officers, except those of the medical branch of the service, should hold commissions unless they be graduates of that institution.

Commander W. M. FOLGER, U. S. N.—It is not difficult to agree with the essayist in all that he says in regard to a needed reorganization of the corps of officers. This unfortunate subject has been argued and written upon until all branches of the service are thoroughly tired of it, and probably all would welcome any system that could be irrevocably fixed by law after a fair consideration of evident necessities by the two naval committees. It is to be hoped that this subject may be settled in the near future, if need be, even without counsel from committees of line and staff officers. A settlement is wanted almost at any price.

I am, however, particularly struck with the author's remarks upon the necessity of a higher status and the need for a more thorough training for the enlisted force.

No war was ever successfully fought out, but few battles have been won, with a mercenary force, and to a very large extent our enlisted men are pure mercenaries. There were twenty-four different nationalities represented in the last vessel which I commanded, a 1700-ton gunboat, and I confess to a feeling of anxiety as regarded the possession by the crew of any national American sentiment or feeling. The best marksmen were foreign-born, and the vessel stood well in the Departmental records of target firing, but had the target been a Scandinavian enemy I should have anticipated wild shooting.

I think that many officers will agree with me that a visit to an English war vessel leaves one pronounced impression. It is a profound admiration for the big, ruddy-faced, bulldog-looking crew, homogeneous throughout, English, Irish or Scotch, but all Queen's men to a man, all curiously of an age or size, all marvellously well drilled and disciplined. Such fellows are and always have been capable of a national idea and of fighting for it, fighting to win; and without such men "behind the gun," fine ships, fine guns and fine officers are of precious little use. We find little to envy in foreign material nowadays, and in intelligence at least our commissioned personnel is fairly presentable, but we are deplorably deficient as regards a definite percentage of our enlisted force.

I would like to see the Navy Department make the attempt to fill the enlistment vacancies with none but American born. There are thousands of idle and unemployed Americans in our large interior and far western towns, and if to these were made clear the emoluments and possible future prospects of our naval seamen, there would be no lack of applicants for the U. S. service.

The army has recently followed a severer method in the selection of recruits with marvellous success.

It is not enough to make the standard simply American citizenship; we will fail in getting the national feature, the most important item in

the whole naval establishment to my thinking. I would indeed prefer to send our ships out half-manned with Americans, and trust to patriotism filling them up when war comes, than to follow the present system of gratuitous education to a lot of foreign-born mercenaries.

The American, while in one sense independent in his bearing and as good as his master, as befits his heritage, is perfectly amenable to discipline, far more so as a rule than our enlisted foreigners. The essayist pointedly says: "It is noticeable that no marines are considered necessary to secure subordination in the naval militia." I wish he had added that they are perhaps entirely a home product.

Having thus secured men to handle the guns and engines who will be in sympathy with the ideas that sent them sailing, with the nation which pays for their services and which expects a great deal from them, men of the same blood and early training at least as their officers, then educate them and render the service attractive so as to hold them; and I believe this is possible.

Commander J. N. HEMPHILL, U. S. N.—I congratulate Lieutenant Fullam upon having handled a most delicate subject in a most masterly manner and in a way that must carry conviction. Although there are one or two statements with which I cannot agree, I feel that the writer should be supported by all officers who can give testimony in favor of any part of his paper.

There is no doubt but that the difficulties that beset the subject of the reorganization of the Navy would be removed by a commission taking a cruise on ships *in a squadron*, thus obtaining an insight into the combination as well as unit, if the commission would look through the right glasses. No one can deny that the ship is the basis of all naval requirements, therein differing from the Army, and therein preventing most comparisons with that branch of the Government service which so many love to introduce into their arguments.

As to promotion, there are such a lot of bills and so much discord about the subject that most officers are inclined to think "How happy we could be with either if t'other dear charmer were away"; so for the sake of harmony I will not touch on that.

Reduction of the number of corps in the Navy should be the first step towards reorganization, and Mr. Fullam has shown very clearly and ably the manner in which it could be brought about, all of which I most heartily endorse. But I would go a step farther and say let no more civil engineers or professors of mathematics be appointed. The *ship* does not require them, and when the services of such experts are needed on shore it would be much cheaper to engage them for the occasion; and so far as civil engineers are concerned, their duties have been, are and could be most satisfactorily performed by the line. In making these suggestions I am looking at the subject from a business standpoint, "with malice towards none but with charity for all," especially for the Navy.

The idea of having a training-ship for the purpose of teaching officers

our harbors, piloting, etc., is good. Although my cruise on the Fern was a trying one, I am thankful that I had it because of the knowledge of our coast thereby gained. That vessel, by the way, would be as suitable for the purpose as could be found without special provision by Congress. Coast survey work gives officers accurate knowledge of the places where the work is done, but as a general thing only one or two harbors are surveyed by the same party, consequently that school is limited.

Regarding the marines, I think that they should be turned over bodily to the Army and should be replaced by an equal number of blue-jackets, which would give the desired increase of men to both services. This plan would also cost the Government only one-half of what would be the expense should an increase of both the Army and Navy be made under the present system. While on the Station Bill Board several years since, I became convinced of how much the Navy does *not* need marines on ships.

Trusting the men and making them feel their responsibility will produce a happy and efficient ship. When that is done and they see that you are really working for their welfare, no men will appreciate your efforts quicker than the blue-jackets, and none will give more and better results in return for your labors.

In conclusion I wish to emphasize by repeating that Mr. Fullam has set the proper course in showing that the ship is the basis of reorganization, and that an efficient ship is the standard compass for the "reorganizers."

Commander C. C. TODD, U. S. N.—The service at large owes many thanks to Lieutenant Fullam for so cogently focusing the essential and pressing needs of the Navy personnel. There should be but one point of view, and that from *the ship in time of war.* Any officer who has served on board a modern ship cannot fail to have observed that in recent years there has been a gradual but marked increase in the idler forces of our ships' companies. And when it is remembered that as this element is increased the efficient *working* force must become correspondingly reduced, and, further, that the idler force is always at its maximum, while the working, fighting force is, from causes incident to service, rarely full, present conditions become a positive menace to the fighting efficiency of our Navy.

It is generally conceded that in future naval conflicts casualties will be very great among officers and men, and it is certainly true that in an action between several vessels with a modern battery, to give full value to her fighting strength, *every gun* should have its own crew, an all-round fighting crew, one that can be shifted from an 8-inch gun to a 6-pdr. or from a 13-inch to a 1-pdr. Such a crew for a ship must of necessity be composed of blue-jackets, which is the only element among the enlisted men that get the needed training aboard ship. This applies to the officers as well as the men. As the room available for numbers to be carried is limited, it becomes apparent that the idler force must

be minimized in all directions among the officers and men, and the essayist has clearly pointed out the first and most important step by the removal from our ships of the marine force. No one can question the past brilliant and efficient service of the Marine Corps, but the only fighting units now needed in a modern ship is the all-sailor, half-soldier blue-jacket of to-day. The strictly fighting element, the blue-jacket, must be the prime consideration. There is no room aboard our ships for any other type, nor can any reasonable argument be advanced to prove the contrary.

The sea officer and the sea man have never, in history, been so essential to successful fighting of ships as they are to-day, and anything tending to hamper these two elements should be ruthlessly swept away.

The clear reasoning of the essayist is unanswerable, and will cause many to realize the responsibility that rests upon the officers and the men, to which they will surely rise in time of need. It is to be hoped that all will read and profit by the reading of this most admirable paper.

Captain P. F. HARRINGTON, U. S. N.—The chief purpose of the U. S. Naval Institute is the dissemination of professional knowledge, and towards that object the essay now under discussion contributes much that is of far-reaching importance to the Navy. It is to be regretted, therefore, that valuable information and opinions have been connected in a controversial tone.

I do not desire to enter the troubled field of controversy, yet, before offering some comments upon the meritorious features of the essay, it is impossible to pass other parts unnoticed, lest silence should give the impression of consent to statements which are directly opposed to the convictions of a large number of naval officers.

Knowing well the opinions of those officers upon the work and results of the commission referred to in the opening paragraphs of the essay, I assume to represent them in expressing a strenuous dissent from the essayist's statements of fact and inference relating to that work and its results. A large body of officers believe that the enactment into law of those results would inflict upon the Navy injuries which could not be effaced during a generation and following the repeal of such a law.

I will not enter upon details further than to say that the assertion is not based upon any consideration of the influences referred to on page 86, though it appears that nearly a quarter of a century in the Navy has not given the essayist a clear idea of the wide extent and subtle power of influences.

The history of our Navy in war points to the fact that, whatever value is attached to tactics and to superior ordnance, the skillful handling of guns has been the chief cause of our naval success; and much of hope for the future lies in our devotion to the science and art of naval gunnery.

It is then a supreme question through what means and by what class of men we may secure that best defense of a rapid and well-directed fire upon the enemy.

In the class of officers, the accomplished seaman is to-day more

essential than ever. In the direction of the ship upon tactical principles and for development of gun fire, torpedo and ram, a profound and exact knowledge of the powers of his vessel, a quick apprehension of the relation of the adversary in any circumstances of wind and sea, an intuitive perception of the correct course to be pursued, are elements of decision which characterize only the men who spend their lives in the study and practice of naval warfare. In no other profession is it so fatal to be "caught aback." This is well understood in foreign services, and it is to be regretted that the circumstances of our own Navy do not permit officers to spend their lives more continuously at sea. For mere landsmen by habit, however extensive their naval thought and acquirements, cannot control a ship under way with that facility which comes only to the practised seaman.

In brief, your ship will fail in action unless the captain and those who succeed him in command are seamen, embodying life-long naval thought and action.

The same principle of habit, of life-long environment amid waves, of meeting all the surprises and accidents of the sea, of perceiving instantly the appropriate or necessary action in difficulties, points to the sailor as the man for the gun.

A dozen men habituated to the sea are worth, in the control of the guns, a thousand bred and trained on shore. Modern guns of heavy caliber are moved chiefly by machinery more or less intricate, and they are managed in all navies by the seamen. Sailors, accustomed to the more simple tacks and sheets of days not long past, have readily adapted themselves to the new conditions and become a living part of the new machines. As we all know, they pick up the tricks of modern gun machinery with wonderful readiness and handle the guns in any weather. With their sure sea legs, they need only practice at sea and in the fleet to master the guns. The sailor is to-day, as he has been through centuries, a certain reliance, and it is to him that we must trust our guns.

If the sailor, who works the ship and takes care of her, is not the best man for the gun, it is time the best man should be found. If it be true, as the essay says (p. 108), that it has been stated publicly that seamen are no longer needed in the Navy, we of the Navy ought to know what class of men should replace them, and we cannot be too earnest in the inquiry. I do not hesitate to affirm that in loyalty, discipline, intelligence, the blue-jackets are inferior to no other class of men, while in adaptability to all kinds of work and general usefulness he is superior to all others for service afloat.

The sailor class should be fostered, and the gradual increase in the number and capacity of our seaman gunners is an essential condition of our naval efficiency.

The adaptability of the sailor class to all kinds of duty is one of the peculiar elements of his usefulness. The sailor will manage a boat under oars or sail, heave up and handle heavy anchors, work aloft as required, coal ship, work as fireman or coal-passer, man the heavy guns, take charge of the rapid-firing guns, steer the ship, land as an infantryman or with

field artillery, perform many other varied duties, and take his pork and beans with equal readiness. And he will do any duty in weather which will make a landsman dread that he will die, and, later, fear that he will not die.

The sailor to-day can do three-fourths of all the work required in men-of-war. In all navies the sailor class has been found to be the most efficient for varied duties or all-round work.

The training of the seaman, both officer and man, is best accomplished at first in small vessels under sail. There is no other kind of experience by which the seaman acquires so rapidly and thoroughly an instantaneous perception of conditions and readiness of resource. This training should begin very early in life; and its complement is the later service in modern war vessels. The practical education is completed by our present system of instruction in guns, torpedoes and electricity. Our Navy has now, fortunately, a large body of officers and men who have developed under this progressive instruction.

The men for the engine-room should be trained upon parallel lines. Precisely as the seamen rise to be warrant officers and chief petty officers, the trained engine-room men should grow into warrant engineer officers, machinists, and chief petty officers of the engineers' force.

To accomplish this development in training most systematically and effectively, the seamen and engineer classes, both officers and men, whether at the Naval Academy or in the service training ship, should serve, before reaching manhood, in small vessels, fitted for sailing or for steaming, or for both.

Training in the shops on shore should be limited strictly by its correlative and subordinate importance. For, although the machinery of almost all great industrial establishments is far more complex than any installed on board ship, it is the habit of life at sea which must be cultivated early in connection with training in the machinery which both seaman and engineer must use. It is my profound conviction that such training only can give us the specially skilled sea people we ought to have for our superb warships. We should live more at sea.

At the head of the crew is that noble body of leading men, the petty officers. Their services should be enlarged, and they should be treated with entire confidence, in a word, *trusted*. I think that even now we do not make the best service out of our petty officers, do not give them full control as such. Men will prove reliable largely in the degree in which reliance is placed upon them. But how can we expect the blue-jackets to respond to confidence when they see even their petty officers not appropriately employed and often under supervision of sentinels? The Navy is slowly but surely breaking away from unnecessary watch and espionage of the men. We shall see the enlisted man fully trusted and respected in the care of his ship and its duties, and his character raised by a systematic confidence in his integrity and inherent worth.

The gun is the most important part of a modern war-vessel. Certainly every pair of turret guns should have at least one officer. It has been suggested recently by an officer experienced in handling turret guns, that

all the larger calibers will require double gun's crews. Very rapid fire of heavy guns cannot be maintained by one set of men beyond a brief period. This is but an illustration of the necessity, stated by the essayist, of a reserve, an increase in the number of officers and men for the service of the guns when on a war basis.

While the essay is conspicuously lacking in suavity of mode, it puts forward a great deal which is truth and nothing but the truth. I regard so highly its contents, in the main presentation of ship organization, that I am unwilling to detract from its force by minor criticisms. Similar views have been formed in my mind for years past, and in October, 1886, in the discussion before the Naval Institute upon the essay of Captain A. P. Cooke on Naval Reorganization, I made the following statement of opinions as to a homogeneous crew for a warship, opinions which further service and observation have but confirmed:

"Mr. Chairman and Gentlemen:—I am unwilling to pass without dissent the views which have been expressed by one of the officers present with regard to the office and employment of the naval engineer.

"The care of the engines and boilers of a war vessel is purely mechanical duty. At sea, the lubrication of the machinery; the prevention of heating in bearings; the regulation of the supply of water to boilers; the firing; the stopping, starting, and reversing of the engines at the signal from the officer of the deck, and all the other usual duties of the officer in charge of the engine-room, are practical matters in which unlettered men become expert. In port, the examination of engines, fitting brasses, cleaning boilers, and all repairs to machinery are solely the work of machinists, boilermakers, coppersmiths, blacksmiths and other artisans, whose handicraft has been acquired in manufacturing shops and on board ship. During the Civil War the management of the engines of our vessels was very largely in the hands of men brought from machine shops or from the merchant marine, who had little knowledge of books and scientific steam engineering. They understood the working of boilers and engines; they could handle tools and repair machinery; and they did their work well; but they were not men of scientific attainments nor even of liberal education. The younger line officers of the Navy, graduates of the Naval Academy, have been appointed, under the orders of the Navy Department, to perform duties in charge of the engines of our war vessels while under steam. Many of us can testify to their rapid acquisition of knowledge and their ultimate capability and efficiency when in charge of the engine and fire-rooms. The engineers of the great steamers, which cross the ocean at high speed and without stopping during a voyage, are not scientific men. The majority of them spring from the shops of shipyards and continue to discharge during life the laborious duty of running a ship's engines. When accidents to machinery occur on board ship, the senior naval engineer directs what repairs shall be made, but he does not make them, for that is the machinist's work. Indeed, the engineers of the Navy at sea are now chiefly engaged in superintending the performance of the machinery. A few of them stand watch in the engine-room, but the greater part of this duty is done by machinists and by young line officers.

"The more highly educated the professional engineer, the more averse he will be to the routine duties of the engine-room; and with reason, for it seems irrational to educate a man in all the higher branches of the science of steam engineering and then put him to do a life-work of running engines, in which work his scientific acquirements will prove of little use. Some experience in the engine-room, in working engines and boilers, is necessary to the complete education of a steam engineer; but, if running engines is to be his chief duty in the Navy, a scientific education is unnecessary; if he is to be employed in higher duties, in the superintendence of machinery afloat and of the manufacture and design of machinery on shore, he must be relieved from the ordinary watch duties and the daily work of machinists on board our ships. High professional research and daily mechanical employment are not compatible, except in rare instances. We do not find, often, science and mechanical skill combined in one man.

"I conceive that the engineers of the Navy should be employed chiefly to superintend the machinery of cruisers. Some may be stationed on shore to inspect the construction of machinery. A few, and only a few in our small Navy, will be required to engage in designing and construction. The great majority of the corps should find their work in charge of the engineer's department of war vessels; and for this duty their professional education should be extended. They must have experience in the workshops and in the management of engines and boilers. They should be practical men, accustomed to consider all difficulties with machinery and to suggest ready remedies, and competent to direct the efforts of the engineer's force so that the engines may develop the best results with certainty. They should be able to judge, from a scientific point, the performance of machinery and to project improvements upon it. They should be experts in machinery of all kinds and competent to prepare reports upon new engines which they may view abroad.

"One or two professional engineers on board each large ship should be sufficient. To run and repair the engines of our ships we require a body of machinists, under the orders of the superintending engineer of each vessel. These machinists should be schooled in the machine shops and in working engines and be expert in the use of tools. They should do the work which is unsuited to the rank and acquirements of scientific engineers and which professional engineers do not perform. Proper grades for promotion, permanence of appointment, and longevity pay, will secure reliable and capable men for this service.

"I do not agree with the essayist that the employment of line officers in the engine-room should be continued to such an extent that they may be ultimately detailed for duty as chief engineers. The line officer's occasional employment in the engine-room is useful in its results; but I consider that we shall not draw for each ship from the body of line officers, whose minds must be largely directed to other vital acquirements, officers of the special knowledge desired in the superintendent engineer I have described.

"The non-combatant elements in our ships should be reduced, elimin-

ated if possible. By non-combatant element I mean that large class of men on board our ships who do not take part directly, and are not trained to take part, in working the great guns and other weapons. At general muster the long line of non-combatants is appalling. Our crews should be homogeneous in nationality, in class, in capability, and in training. The able seaman will be in the future, as in the past, our force, our trusty agent, and every other type of men on board should be assimilated to him. The engineer's force should be trained at the great guns, at the secondary batteries, with small arms, and in the boats. Few servants should be enlisted; indeed, they might be taken from the sailor class. Abolish paymasters' clerks and naval cadets at sea, and put the remaining steerage officers into the wardroom. In conflicts between ships, ramming is most probable; ships will come together; and, for such an event, every man in a ship should be trained, each with a proper weapon, to keep his own deck or to go on board the enemy.

"The argument of homogeneousness extends to the marines and would exclude them from a vessel of war. It does not seem wise to have a special class of men for one arm, men who do not work in all the duties of the crew. The marines are now employed on board chiefly as sharpshooters and as sentinels over Government property and refractory sailors. But the seamen of our Navy must become sharpshooters, and they must learn to guard themselves and their ships. A proportionately large part of the crew must be employed in the engine-room; outside of it there should be but one class of men, the able seamen, who should be entrusted with every duty and office of the ship under the commissioned officers.

"I have outlined an opinion, in which many officers concur, based upon the principle that no man should be retained on board who is unable to perform one, and, usually, more than one, of the essential duties of the vessel of war. The elementary training should be done in separate ships. There is no place in a ship prepared for war for naval cadets and clerks, who take up the room of officers; nor for boys and servants, who exclude as many fighting men ready for any work with any weapon in any part of the ship; nor for yeomen, writers, schoolmasters, ships' corporals, lamplighters, tailors, barbers, buglers, printers, painters, etc., unless they are seamen or form a part of the fighting force."

Lieut.-Comdr. URIEL SEBREE, U. S. N.—For the most part I agree with what Mr. Fullam has so well said in his article. In regard to the reorganization, as he says, the efficiency of the ship, and, therefore, of the Navy, is what should be considered. From the nature of the problem it is impossible for the officers to generally agree. It is something for Congress to decide what is best for the Navy and the country irrespective of whom it hurts or benefits. If it were possible for the naval committees to spend a month on board vessels in commission, with a view of getting information as to what is needed, they would frame a bill which, in my opinion, would be acceptable to the line officers as far as the line and staff features are concerned.

The idea of having a vessel detailed for duty on the coast for the instruction of officers in regard to harbors, piloting, etc., is a good one, but it is hardly probable that one will be spared for that purpose. The Coast Survey is a most excellent school for officers in that respect. The light-house inspectors also have unusual facilities for gaining knowledge of that kind in their districts. If it could be done, each coast or lake district, thirteen in all, should have a lieutenant or ensign detailed as assistant inspector for six months or a year. If this could be done we would soon have a large number of officers with accurate knowledge of parts of the coast. At present the Light House Board, properly, does not want more officers for inspectors than are absolutely required to do the work of the Light House Establishment. But I do not think the board would object to assistants who were sent with the object above-mentioned, provided no additional expense was required of the Light House appropriation.

In regard to warrant officers. Some years ago, when ordered as executive of a ship without sails, I thought a boatswain was not needed on that class of vessels. Since making the cruise without one I have changed my mind. A good boatswain is a very valuable man to have on board a ship whether she has sails or not. In case of war, an officer ordered to command a merchant steamer would be fortunate to get one or more warrant officers. They would at once be doing the duty of commissioned officers. Commanding and other officers should be on the lookout for eligible men in their crews and recommend them to the Department for acting appointments.

As for the blue-jackets, including the petty officers, most officers as they grow older in the service respect the blue-jacket more. They are the best men to be had for all-around work. Suppose an officer had some desperate and important duty to perform that was not necessarily in the usual line of the blue-jacket's work, such, for instance, as transporting 100 men two or three hundred miles by rail, and then to blow up the lock of a canal or to seize some important position on a river or the coast. If he had the choice of the local militia, any other militia, the regular army or marines, or 100 blue-jackets of the regular landing force of a ship in commission, I think few officers would hesitate about choosing the blue-jackets first.

As to marines on board ship. On my last cruise we had 36 marines with a total complement of 337 men. The marines were very good men, but I would have been willing to take 20 or 25 blue-jackets in place of them. When coaling ship it does not improve the disagreeable situation to have from 15 to 30 marines lying around in the port gangway waiting for the sailors to get the coal on board.

I think that the sailors can be taught to do all the duty now done on board ship by the marines, and if an equal number of blue-jackets are put on board in place of the marines the ship would be a more efficient fighting machine. Let the marines stay on shore, as suggested. I would not do away with the "vested rights" of the marine officers. It might be for the benefit of the service to give all marine officers who are graduates

of the Naval Academy commissions in the line with their own class. This would trench on "vested rights" of the line officers below them, but if it benefited the service it ought to be done.

As to engineers. Two commissioned engineers on large ships, and one on small ones, are enough. It is not business-like to have a highly educated commissioned officer doing the work that a machinist can do and does do on merchant steamers. Make the machinists who are worthy and competent, warrant officers.

In this connection I think all the machinery on board should be under the general charge, as to design, installation, repairs and operation, of the engineers. This thing of having one engine under the navigator, another under the executive, and others under the chief engineer, is not conducive to efficiency or economy and should be changed. Put them all under the charge of the officer whose education and experience ought to make him the best and most efficient man for that work.

The duties of paymaster on board ship could be efficiently performed by a line officer. It would give one more military officer. Do not appoint any more paymasters, and whenever a vacancy occurs in the Pay Corps make one more line officer. The younger men in the Pay Corps will soon have so much rank that they will not have to go to sea any way, so no "vested rights" would be troubled.

Rear-Admiral S. B. Luce, U. S. N.—I have read this well-written and, with one or two exceptions, well-considered essay with unusual interest. It reached me, unfortunately, too late to offer but a few hastily-written criticisms.

The first passage that strikes me is the following, on page 84: "It is from the deck of the ship that the problem should be considered." This is one of the few indications that have lately come to my notice of a reactionary movement against the tendency of the whole Navy to get everything on shore. It is a hopeful sign of the times.

The remarks on "vested rights" are sound. There has been too much class legislation for the Navy. A certain captain in the English Navy, with whom I was acquainted, an officer of exceptionally high professional standing, was about to be retired as a captain, having reached the age limitation before his time for promotion to flag rank. On expressing my sympathy for what seemed a great hardship, he said: "It is hard in my individual case, but our system of retirement and promotion is for the *good of the service*." In my many talks with English naval officers I have found that, with them, "the good of the service" is invariably the first consideration.

That should be the guiding principle with us.

The remarks about the necessity for a school of pilotage are deserving of consideration. Coast survey duty is the nearest approach to it we have; when the coast survey comes more in touch with the strategic studies of our coasts the essayist's views will eventually be realized, there is little doubt.

The chapter on warrant officers is excellent, as well as that on petty

officers. Seamanship has been languishing in the Navy for some years past, but is not yet quite a lost art. There crop out, from time to time, signs of resuscitation. We must have seamen, and those seamen must be trained and the best of them promoted to petty and warrant officers. To do this properly there should be a gunnery ship. I have seen the experiment tried and know perfectly well of what it is capable. A gunnery ship properly conducted is a species of normal school for petty officers. That we have never taken a hint from the English and French gunnery ships is one of the most striking illustrations of our defective organization. Under our system a gunnery ship, with all its possibilities, is simply hopeless.

All that is said of the blue-jacket meets with my unqualified approval. The trouble is, there is no one to look out for his interests. The most extraordinary thing in the whole of this business is the want of appreciation on the part of somebody, I do not know who, of the importance of the office performed by the captain of a great gun. Just fancy a great line-of-battle ship of the Massachusetts type rushing into battle. The main reliance is placed on her deadly prow and on her two 13-inch guns. If they perform their work the fight is won. But who controls them? The seaman at the wheel and the captain of the gun. If in the supreme hour of trial these are found wanting, the battle may be lost and the honor of the flag tarnished. The commanding officer gives his orders, of course, but the seaman at the wheel, by a spoke or two one way or the other, it may be through nerve or the lack of it, may cause a direct blow and success, or a glancing blow and a lost opportunity. And the commanding officer may give the order when to fire, but if the gun captains be not cool and steady hands and thoroughly trained in the use of the great engines of war they control, then their firing will not be good and the efficiency of the ship will be heavily discounted. We pay millions of dollars for one of these great mobile fortresses; thousands of dollars for each gun, and hundreds of dollars for each charge of ammunition, to say nothing of all the brain work, the educated talent in designing, the skilled labor in constructing and the time consumed in putting all together, and yet the trained intelligence that is to utilize all this in the crucial test of battle is left to mere chance. It is inconceivable. And then consider the possible results. In the one case, victory and the glory of the flag; in the other, defeat and national humiliation.

When the rating of seamen-gunners was first introduced it was intended that they should be trained exclusively for gun captains and have comparatively good pay. But when they came to be assigned to duty as machinists, lamp-lighters, ship's painters and the like, their chief characteristic was lost and their pay was cut down. A seaman-gunner now receives $11 a month less pay than the captain's cook and $4 a month less than a bugler. The captain of a 13-inch gun, or, speaking generally, the captain of a great gun, should have the highest pay of any petty officer in the ship. But to entitle him to this he should be carefully educated for the position. I am a thorough believer in education, but I do not believe in misdirected education. If we are to train a man for life on board

ship and for the skilful handling of ships' guns, I do not believe in so shaping his course of training as to fit him for civil life.

These and kindred topics have been discussed a great deal in the service with little or no result. I have come to the deliberate conclusion, therefore, that there is something wrong in our system. The fault lies in our form of naval administration. The head must be sound if the members are to work in harmony.

In an article entitled "Naval Administration," contributed to the Proceedings of the U. S. Naval Institute in 1888 (Vol. XIV., No. 3), I undertook to trace the history of our Navy Department, show its defects and point out the remedy. I have seen no reason since that time to change my views. I quoted President Cleveland as saying: "The conviction is forced upon us with the certainty of mathematical demonstration that before we proceed in the restoration of a Navy we need a thoroughly reorganized Navy Department." These words were true at the time they were written, and they are true to-day. To purify a stream you must begin at the fountain-head.

I do not pretend to say that a reorganization of the Navy Department is the panacea for all naval ailments. You cannot eliminate from human institutions the element of human imperfections. The mentally poor are always with us. But it stands to reason that no scheme of reorganization is worthy of serious consideration that does not include the head of the system to be reorganized.

In an essay containing so much that is good, so much that commends itself to one's approval, I regret to find one recommendation impossible to indorse.

I believe in keeping the marine guard on board ship. The idea that marines are placed on board ship in these days to keep sailors in order I dismiss as utterly unworthy of a moment's consideration. I yield to no one in my high opinion of our seamen. It is my pride that I was brought up among them. I gladly concede all that is claimed for them. As infantrymen on shore, as serving with a field battery, on camp duty, as sentries serving on shore in *any* capacity, in peace and in war, I can testify of my own personal knowledge that our sailors have always done well. It is no compliment to say that in many respects they are far superior to marines.

In the several encampments of the naval brigade of the North Atlantic Station I have often seen blue-jackets posted as sentries and I know that they were faithful in the performance of their duties. They took to the duty naturally, and it seemed quite in accordance with the fitness of things. But in his own element it is quite another matter. To see blue-jackets posted as sentries on board ship would be enough to shock one's sense of military propriety. The idea of a sentry and a soldier cannot be dissociated. It is the sincere regard I have for the sailor that prompts me to enter my protest against the attempt to make him a hybrid soldier. It is not that he would fail in his duty; it is not that he is "not to be trusted." Officers who say so show their training as sea officers to be defective. Let us have no false issues. It is because soldiering is not

his vocation. That he can perform at need the duty of an infantryman is so creditable because it is not his vocation.

The marine guard on board ship is the outward and visible sign of the military character of the environment. It serves to keep alive and foster the military spirit. To take the marine guard from the ship is to deprive it in a great measure of its military aspect. If it is said that it is only for show, the reply is that show, appearances, the "pride, pomp and circumstance of war" go for a great deal in military life. But it is for much more; the marine guard belongs to the fighting force of the ship just as much as the seamen do, and although an infantryman, he can be made a good marine artilleryman. Marine officers are just as much line officers as sea officers are, and have the same adaptability. One of the best signal officers I have ever seen on board ship was a captain of marines. But they preserve withal their distinctively military character. And it is that distinctively military character that gives them their value in the economy of a ship of war.

Take for a single example the case of a call in a foreign port to protect the American consulate. The presence of marines there is a visible sign all foreigners would understand—that the place was under military protection. The distinctive character of the soldier is recognized the world over, and the all but sacred character of a soldier on post is universally respected. Sorry, indeed, would I be to see soldiering made a part of the regular duties of a man-of-war's man. Sorry would I be, speaking in my character as an American citizen not unacquainted with naval affairs, to see the backward movement of withdrawing the marine guards from our ships. Had I ten thousand votes they should all be cast in favor of preserving their present status and increasing their numbers.

Lieutenant H. C. POUNDSTONE, U. S. N.—I don't wish to criticise any suggestion or statement of Lieutenant Fullam, but would like to put myself on record as entirely agreeing with him.

There can be no doubt in the mind of any reasonable man that *ship* efficiency underlies the whole question of the readiness of the fleet for action. This granted, then anything that interferes with or encumbers the effort to make the ship an efficient fighting machine should be got rid of, no matter what reason it has had for existence.

To fight the ship requires men for the guns (with a sufficient number of supernumeraries to supply deficiencies from sick and casualties), for the supply of ammunition, for handling her, and to work her motive power. To maintain any other force on board embarrasses the ship by just that much and gives her much the character of a transport.

It is without the limits of probability that sharpshooters will be required in future naval actions, and believing that the police duty of any ship can be done just as well, perhaps better, by the sailor, I unhesitatingly endorse Lieutenant Fullam's suggestion as to the withdrawal of the marines from ships; for unless they can be used for any and *all* the duties of a man-of-war's man they are not only of little use, but would add to the greater

or less confusion and casualty incident to action, with no corresponding gain. If they are required to do all of a sailor's duties, why not have sailors, pure and simple, with the fighting body homogeneous?

No one denies the good work or admirable record of the United States Marine Corps, but many changes are necessary to conform to modern conditions of battle, and it would seem imperative, in the light of this, to have all fighters and no passengers.

I am heartily in accord with Lieutenant Fullam as to proposed changes in the engine departments of our ships. In small ships one, and in large ships two engineer officers can superintend all that pertains to the care, preservation and manipulation of the motive power, and the machinists are, or can be found, entirely competent to run and repair the plant.

Lieutenant C. H. LAUCHHEIMER, U. S. M. C.—Gentlemen.—I have accepted the invitation of the Board of Control of the U. S. Naval Institute to present an opinion and criticism on the paper entitled "The Organization, Training and Discipline of the Navy Personnel as Viewed from the Ship," by Lieutenant William F. Fullam, U. S. Navy, lest it might appear from a non-compliance with the request that I in any way endorse the statements made by the author. The parts of the paper which refer to the matter of the personnel of corps other than my own I will give but passing notice, and will confine myself mainly to the strictures on my own corps, as it is evident that a discussion of this feature belongs most appropriately to the marine officer.

The paper resolves itself into the one proposition, that the Navy, in order to be efficient, must rid itself of the alleged fungus growth and be a Navy of the line, for the line, and by the line. The marines must be dispensed with because they stand in the way of the enlisted personnel. So long as they remain on board ship the growth of the enlisted men is retarded, and the responsible positions they should fill must remain vacant. In other words, the essayist endeavors to create the impression that his plea is made for the poor neglected enlisted man, sacrificing all personal gain to the general good of the service. Let us see if he is honest. He insists that the petty officer must be trusted and given positions of responsibility which he has never hitherto been allowed to enjoy, and yet in the same breath he makes a strong appeal for more line officers, who, he claims, are needed for the changed condition of things on board ship, such as the separation of guns by bulkheads and turrets, etc.; and finally he makes the statement that the result of an engagement might hang upon *the presence of an officer at a certain gun or torpedo*. Does this look like more responsibility for the petty officers when the author recommends an increase of line officers even so far as to have one at each gun and each torpedo? Why are we training gun captains if the officer is to fire the gun? To show the want of logic in the paper, the author discusses at length the necessity for a decrease in the number of engineer officers on board ship, and recommends in their places petty officers of engineers, who are to have complete charge of the complicated machinery of our new vessels, with all

that the term implies. Now, why should a petty officer of engineers be trusted with the great responsibilities which we all know are now incumbent upon those in charge of the enormous masses of machinery on board our new ships, when a petty officer of the line cannot be trusted even to fire a gun or torpedo? If one or two officers cannot control the supply of ammunition to the guns, how can the petty officer of the engineer's division be expected to control the supply of coal to the boilers, especially when we take into consideration the intricacies of the means of supplying coal in our modern war vessels? I make this reference simply as an illustration of the entire want of logic which seems to pervade this paper. In fact, nowhere throughout the paper is any argument offered in support of the ideas advanced by the author, but instead thereof we are furnished with bare statements and a few perverted facts.

As another illustration of the absolute want of logic in this article, I must refer to the new phrase invented by the essayist and used by him in speaking of officers of all corps other than the line, *i. e.* vested rights, which he ridicules and speaks of in a generally derogatory manner. His climax is reached on page 93, where he says:

"The captain of a ship, and the officers who are educated for the ultimate purpose of command, must study naval organization in its broadest sense; and their competency to decide upon the general features, functions and relations of all departments, in order that all may be formed into an efficient and harmonious whole, cannot be denied. It is for this duty that a line officer exists. If he neglects it, or is not permitted to consider it, who shall take it in hand? Who is more competent, who is more logically the proper man for the work? It is impossible to dodge the inevitable fact that it is the legitimate duty of line officers to exercise general control over the whole subject of naval organization in all departments; they are not meddling when they assume this function; they are not usurping power nor trespassing upon the 'vested rights' of others; they are simply performing a '*vested*' duty and the one which is most vital to an efficient Navy. If each corps of the Navy is made independent and permitted to reorganize itself; if questions of rank, titles and pay are to be decided exactly as the several corps may demand, and if certain matters which are of comparatively trivial importance in their bearing upon naval efficiency are to monopolize the attention of Congress, naval reorganization will be a dismal failure."

It has always been recognized in the naval service, which was originally organized in accordance with the Constitution, and which receives its support from Congress, that while different parts thereof have their duties designated by proper authority, the whole constitutes the Navy proper, and it could hardly be expected that Congress or the American people would say that there are no such things as vested rights for an engineer, a paymaster or a marine officer, but that, by intuition, *vested rights* do exist for the *line officer*.

The author states that the few duties now performed by the marine

officers afloat could be assigned to line officers, who would also be available for other naval work. As to the few duties performed by marine officers afloat, the author well knows that the sphere of usefulness of the marine officer has increased and kept apace with the changed condition of the Navy, and his duties, if restricted, are not so by any desire of his or of his corps, but simply by regulations which we must consider have been advisedly made; and even though this restriction does exist, it can in no way be considered as establishing the fact that marine officers cannot do duties other than those prescribed. Furthermore, a careful inspection will show that practically the only duty which the line officer now performs on board ship which the marine officer does not is that of standing watch. In place of this standing watch he is the head of a department, is a permanent officer of the guard, with all that this term implies, is in charge of government property for which he is responsible in the same manner that the executive officer is—in fact, he is the quartermaster and the ordnance officer of his detachment, and the duties devolving upon him in this respect are certainly as trying as those of the watch officer are to him. Indeed, it is not an unusual occurrence for marine officers to be called upon to perform, and they cheerfully do perform, duties not strictly in keeping with their military profession and not prescribed by the regulations. In fact, it will be remembered that the Naval Regulation Board, which was convened in 1893, and which consisted of such eminent naval officers as Captain Sampson, Commander Chadwick, Lieutenant Mason, Chief Engineer Farmer, Paymaster Michler, and Major (then Captain) George C. Reid of the Marine Corps, recommended that the marine officer at sea, excepting the fleet marine officer, might be required to stand watch or to perform such other duties as may be assigned to him; but this provision, although recommended by the Regulation Board, was stricken from the regulations after having been agreed upon by the board. Therefore, if the duties of the marine officer at sea are few (which is not admitted), it certainly cannot be charged that this is the fault of the officer or of the corps which he represents, for it must be conceded that marine officers have been and are at all times ready and capable to perform such duty as the Department in its wisdom may see fit to impose upon them.

The author says that there are very few duties of the marine officer which cannot be performed by officers of the line. Is not the converse of this equally true? At the present time sixty-six per cent of the officers of the Marine Corps who are available for sea duty—and this percentage will be increased every year—are graduates of the Naval Academy, the same institution from which the line officer is being graduated, the officers who enter the Marine Corps being frequently the seniors of those who go into the line. Now, if the duties of the officers on board ship need increasing, why not adopt the suggestion of Mr. Fullam and take advantage of the material which is on hand, that is, give the marine officer the duty which he can perform, and which he is willing to perform, in addition to the strictly military duty for which it must be conceded he is much better prepared by his education and training, subsequent to leaving the Naval Academy, than is the line officer?

The author, after discussing the value of landing parties and all that this term means, calmly lays down the rule that this subject is a very simple one, and says:

"It is a fact that infantry drill and the guard duties in the Navy require less ability and less study than a hundred other duties that fall to a naval officer. A simple drill-book and a simple guard-manual are needed, that is all. Unnecessary complexity in these matters has been a great bugbear."

The writer calmly claims that an officer-of-the-line of the Navy is enabled to perform all the duties of an officer of artillery and of infantry in a landing force without much trouble and as well as an officer who has spent years in studying and practicing these duties. With all due deference, I think that most people will doubt this statement, and will agree that a marine officer, who is almost without exception constantly in touch with men ashore and afloat, drilling, teaching, training, studying the human nature of the soldier in that best of schools, experience, might, or at least ought to be able to, perform these particular duties a little better than an officer, however intelligent, who has had little or no experience in such matters. The study of a simple drill-book and a simple guard-manual will not teach an officer the many duties that a marine officer performs, as the essayist would discover if he had more than a cursory knowledge of the subject. It is not the fault of the marine officer that he is not given the command of landing parties, although, if the truth be known, though others may be in command, the moving spirit of the organization is most frequently the marine officer.

It is a pity that the essayist did not name at least one or two of the hundred duties of a line officer that need more ability and more study than does the training of an infantry soldier. It used to be said in the Army that "it takes three years to make a man a good infantryman." The Army officers must have been densely ignorant, or else the line officer of the Navy, as pictured by the essayist, must be a prodigy.

The writer speaks of the recent landing drills of the North Atlantic Squadron, in which "the onlooker could not fail to see that the line officer is equal to all military duties, and that the infantry part brings the least strain upon his intellect." The statement that the infantry part brings the least strain upon the intellect of the line officer of the Navy really should be given no serious consideration, for history has shown the importance of the infantryman, the extent of the study necessary to make him a success; and I doubt very much whether even so distinguished an authority as Lieutenant Fullam would be able to throw discredit upon so important a branch of the Government service by a statement which is unworthy of even a casual reader of history.

The great and overshadowing question which lies at the very bottom of the article is: "Shall the marines be withdrawn from the ships? Is the day of their usefulness on board ship past?" I fail to see in the article a single argument which bears out the author in his contention. In fact, he does not endeavor to make any argument, but is satisfied with making statements unsupported by facts, and which, when diagnosed,

are shown to be but a personal opinion, clouded by bias, if not by ignorance.

The history of the Marine Corps is one which is well known, not only to officers of the service, but to the American people. Its record is one of which not only its officers, but the people of the country may well feel proud. The author himself dares not attempt to cast a single blemish upon its record, and, in fact, it seems that the excellent record of the corps is the cause of the entire trouble. In other words, the marine is too useful, his record is too good, and therefore he must be taken away and some one else educated to do his duty, and who, if the system succeed, will be nothing more nor less than the marine of to-day. Granting that the *morale* of the enlisted men of the Navy has improved—which supposition is not borne out by the number of records of general and summary courts-martial received at the Department—does the author say that if marines are dispensed with on board ship, sentry duty will not have to be done? I do not believe that even he would make such a statement. Therefore, granting that sentry duty must be done, is it not better that it should be done by a class of men educated for the purpose, and who have done their duty for years to the entire satisfaction of the service and the country? Will a sailor be reported more graciously by a brother sailor than by a marine? If so, my experience has been for nothing. Again, from the experience of line officers with whom I have conversed and who have served on the ships where the sentry duty was performed by sailors, I learn that the system is not a success, and one officer said to me, "I hope it will be my last experience on board ship without a marine guard."

In this connection it would be well to see what is the sentiment in foreign navies towards the marines, for in all questions which affect the Navy we invariably look to the large naval powers abroad to see what they do. In the French service, the second largest naval power in the world, the marines were taken from the ships in the winter of 1870-1 in order to man the defenses of Paris, and were found so useful that, notwithstanding the repeated endeavors of the Minister of Marine to regain them, they have been kept permanently in coast fortifications and on duty in colonial ports. To fill their places it has been found necessary to practically create another corps of marine infantry, and we find in the naval budget, under the head "Specialists," side by side with torpedoists, helmsmen, topmen, etc., the "fusiliers." These men, the fusiliers, before going on board ship, receive special musketry instruction, and afterward man the guns of the secondary battery, form the landing company, perform the guard duty of the ship, and remain permanently together as a whole. They are commanded by an officer who has had special training in musketry; they form from one-sixth to one-eighth of the entire complement of the ship, and they are practically what the marines of this country are.

England, whose navy must ever be her bulwark of protection and defense, and is the finest in equipment and personnel in the world, has afloat in her ships nearly 8000 marines, and her estimate in the coming budget increases the corps by 500 men, making a total of 16,000 marines.

Is it not plain that the deliberate action of the two important naval powers is entitled to great weight, especially when their action is based upon experience and is justified by the conclusions reached by our own officers of experience?

The writer endeavors to create the impression that the marine on board ship does not do his share of the work. This is so at variance with the absolute facts that I cannot refrain from discussing this feature at some length. Let us consider the usefulness of the marines on board ship. We all know that the time spent in port is greater than the time spent at sea, but, for the sake of argument, we will discuss both sides. When the ship is in port the marine is called at "all hands," and, with the sailor, "turns to" to clean ship. They clean their own part of the ship, and are stationed at the pumps or otherwise in the general cleaning of ship. They then assist in cleaning and doing general work around the decks, such as spreading awnings, hoisting boats with the rest of the crew, etc.; they keep their arms and accoutrements in good order; they are mustered at quarters and are drilled with the rest of the crew, and, in case of afternoon drills, are similarly drilled; but if there be no afternoon drills, or anything particular going on about the decks, Jackey is allowed to lie around while the marine is continuously on sentry post, generally two hours on and four or six hours off. In the evening, when awnings are furled, housed or triced up, the marine does his share with the rest, and at "tattoo," when all hands except the anchor watch turn in—and even they turn in, as we all know—the only people who are awake around the decks are the quartermaster and the marines, who are still doing two hours on and four or six hours off. It appears, therefore, that if a true statement be made, such as the above, it will be seen that the marine works shoulder to shoulder with Jackey during the day, and stands sentry duty at night while Jackey is in his hammock or sleeping on deck as part of the anchor watch.

Let us now consider the case, if at sea. The marine guard was divided, in the old Navy, into the starboard and the port watches; the moment the watch was set the marine went on watch and did his share of the work around the decks, pulling on ropes whenever sail was trimmed or sail made, doing his share of work side by side with the sailor, and at the same time the watch on deck was keeping up the sentry post, which is more arduous than the lookout kept by sailors. Again I think a fair and unbiased mind will say that the marine does at sea the same amount of work that Jackey does, and that he is not, as the author would like you to believe, "an idler."

The great bugbear has hitherto been advanced that the marine does not coal ship, and in the paper in question the author speaks of a recent instance where, out of a complement of 300 men, 67 men, half of whom were young apprentices not fit to do a man's work, toiled for three days in a hot tropical sun, passing 450 tons of coal on board; that when the same ship was docked later on, 46 men were counted scraping her bottom under trying circumstances, though on both of these occasions there were 30 able-bodied marines on board, half of

whom were standing sentry duty in four watches, while the other half were off duty for the day. This statement is, if true, a very unusual state of affairs. Even if the 67 men were doing the work specified, and the 30 marines were likewise engaged as stated, what more natural than that the question should arise, "What became of the other 203 men—what were they doing?" My experience aboard ship has been to the effect that even though the marines have not hitherto taken part in coaling ship, it is well known that their duties are increased correspondingly with the extra duties devolving upon the sailors at this time, because almost invariably it is the custom to increase the number of sentries whenever ship is being coaled, the opportunities for smuggling liquor being so much greater, and the precautions to be taken correspondingly increased.

The fetich of coaling ship has been used long enough by the author and a few others. 67 men would be considered an abundantly large number in the merchant marine to handle 150 tons of coal in a day. They would be expected to get in each other's way, as they do. Only recently a British man-of-war took in 520 tons of coal in eight hours. On the Pacific coast of the United States, where the merchant seaman is protected by a powerful seaman's union, six men, the entire deck force of a vessel of 2500 tons displacement, have been known to hoist in, wheel forward in barrows and chute into the bunkers 70 tons of coal in six hours, one of the six men attending the steam winch; and this gang was pronounced by the first mate of the vessel to be the slowest and laziest he had ever seen on board ship. I think this practical illustration of what is done in the merchant marine should be a sufficient reply to the oft-repeated and threadbare bugaboo about coaling ship.

The marine on the new ship is even more useful than he was on the old ships, because it is well known that in the new ships, being nothing more or less than floating forts, sail power being dispensed with, and the necessity for going aloft being done away with, the man about deck is to be a useful man and an artillerist. The marine just fills the bill to perfection; by his training he is especially well adapted for his duties on such a ship. The marines have time and again shown their ability at the batteries when they have been thrown into friendly competition with their sailor brothers at target practice, for their training at target practice at shore stations develops in them the necessary qualifications for an expert in the use of a gun that is sighted and fired like a rifle. What a great measure in the interest of efficiency and economy the permanent assignment of marines to the secondary battery would be! The regulation board, hereinbefore mentioned, composed of eminent naval officers, unanimously adopted a regulation so assigning them, but, like other recommendations concerning marines, it was stricken out after leaving their hands.

Surely it is hard that the marine is to have fault found with him because he is trustworthy and efficient. Is the fact that he is trustworthy any reason why other men should not be so? Is it necessary to put a

man on sentry post to trust him? Are marines put in running boats to watch the blue-jacket? Has not the British blue-jacket, with his "loyalty and discipline," grown up in daily contact with the British marine? *There* is a system which has lasted for *more* than a hundred years, and the British naval officer to-day does not find it necessary to try a new system in order to make his men trustworthy, to progress toward perfection, in fine, to make them "equal to the marines." The British workman has been engaged in shaping his material until his light troops are what they are. Foreign naval authorities do not appear to agree with Lieutenant Fullam that men should be equally capable in all branches of ship duty, but it seems to be the general practice to educate men to be specialists.

The seaman can never, from the nature of circumstances, fill the requirements for a trained military force on shore to oppose the military troops in foreign countries when called upon to land from the ship. His duties are most important in his own branch, and he, like the marine, requires special training in the details of his profession. Neither can replace the other, and both are essential to an efficient Navy, each supplementing the other in making a perfect whole. Look at the different circumstances under which they go on board a ship going into commission. The sailors, who have been recruited on receiving ships at different navy-yards to serve for three years, and many of whom have been possibly two or three months in the service, are brought together for the first time on the deck of a new ship. They are assigned to gun divisions and companies, under the officers. They are new to the ship, to each other, and to their officers, and their officers are new to them. They have not been under discipline for some time, some of them never. The officer, who has been for three years on shore duty, or in the Coast Survey, is a trifle out of practice in drilling and commanding men; therefore, it takes some time for all hands to get shaken down to their work, to know each other and to familiarize themselves with their duties. Even then the crowded deck of the ship is no place for instruction in the school of the soldier, or to exercise men at company drill or in battalion manœuvres. Again, the exigencies of the service require frequent changes of sailors from one division to another, which is discouraging to officers and men; for an officer, after he has taken pains to bring his division to a state of efficiency, knows his men and feels himself in touch with them, and they have a mutual liking and respect, and does not relish finding some morning that two or three of his men have been replaced by new ones from another division.

The marine is enlisted at a recruiting station for five years, and immediately goes under training to perfect himself in the details of his profession. When a guard is needed for a ship, only well-drilled soldiers are selected, commanding officers being required to send the best men at their disposal; consequently the marine guard goes to the ship thoroughly trained and disciplined, having been drilled together in the school of the soldier, company and battalion manœuvres, instructed at aiming and sighting guns and target practice; they are accustomed to

discipline, to their officers and to each other. The officers have been continually with troops during their tour of shore duty and understand their men. Once on board ship, the guard, barring casualties, remains the same during the cruise. There can be but one result from this condition of affairs: the marines are bound to be as proficient a body of men for service afloat or ashore as can be found.

The essayist assumes that the blue-jacket is necessarily more generally useful than the marine, but there is no argument advanced or reason given to show that this is the case. As a matter of fact it is not the case, and I challenge the production of any statistics which will sustain such a contention. Nor do the records of the Department bear out the author on the subject of the Jackey being the equal of the marine at target practice. My own experience and conversation with many officers who have given the subject attention lead irresistibly to the conclusion that Jackey is not, by intuition or by training, as good a man at the gun as is the marine.

Does it not appear strange that such eminent naval officers of the old school as Farragut, Porter, Stringham, Paulding, Dupont, Sands, Rodgers, Foote, Davis, Worden and Dahlgren, and such experienced naval men of the present and more modern school as Kimberly, Jouett, the late Fyffe, Meade, Carpenter, Beardslee, Potter, Kautz, Remey, O'Kane, O'Neil, Taylor, Shepard, Brice, and many others, who have had command of ships, should have placed themselves strongly on record at the headquarters of the Marine Corps as to the necessity and usefulness of marines on board ship? Is it right that such eminent authority, based on actual experience, should be thrown aside and the ideas of a young officer of practically no experience be taken in lieu thereof? This contention against the marine having been stirred up by young, inexperienced officers, who have never been in action and whose idea of the usefulness of the different branches of the service is based entirely upon theory, the matter was fully investigated by the present Secretary of the Navy, who, having duly considered the entire subject, seems convinced of the necessity of retaining marines. I quote from his annual report for the year 1895 as follows:

"There has always been more or less objection on the part of some officers of the Navy to marines on board ship, but as marines have constituted a part of our naval establishment, both on shore and at sea, from its infancy, it may fairly be presumed that experience has, in the opinion of those who control, demonstrated the wisdom of maintaining this branch of the service. The Department has recently had occasion to consider carefully whether, under the conditions at present existing in the Navy, it was for the interests of the service to depart from the long-established custom and entirely dispense with all marines on battle-ships.

"The modern battle-ship is largely a floating fort. It remains, as indeed all naval vessels under steam alone must for much the greater part of the time, in port, where it exercises its crew in landing parties and infantry drills far more than was permissible when ships were for

long periods at sea. These drills on shore and afloat, together with the handling and firing of great and rapid-fire guns, constitute also a much larger proportion of the actual experiences of the modern sailor than of the old-time tar, who was much of his time occupied in performing the duties peculiar to sailing vessels, and it is precisely in infantry and gun drills that the marine is or may be an expert. It would therefore seem that there is far more propriety in having the ship's crew composed in part of marines now than there could have been in the days of the sailing ship.

"No reason appears why marines should not man a portion of the guns on board ship as well as handle small arms, nor is it perceived why their officers cannot, subject to the orders of the captain, command gun crews and even gun divisions. The fact that marines are enlisted for five years, while sailors are only enlisted for three, is clearly an argument in favor of retaining the marines; and the having on board of two different organizations, if a proper spirit of rivalry between the two is encouraged, ought to be considered another advantage, especially in cases of insubordination. For these and other reasons the Department decided to put sixty marines and two marine officers on board the Indiana, and it will put marines on the other battle-ships as they are severally commissioned."

I also quote from Special Circular No. 16, dated July 31, 1894, as follows:

"Advantage is taken of this opportunity to state that the Department, after maturely considering the subject, and particularly in view of the honorable record made by the United States Marine Corps, which has been a part of our Navy since its organization, is convinced of the usefulness of that corps, both ashore and afloat, and of the propriety of continuing it in service on shipboard."

In this connection I desire to invite attention to two prize essays contained in the Journal of the Royal United Service Institution for April, 1896. The essays in question are upon the topic, "In view of the Changes which have taken place in the Composition of Fleets during the Present Century, what System of Entry, Training, and Distribution is best calculated to ensure an Efficient Body of Officers and Men of all Branches for a Peace and War Establishment?"—a subject, it will be seen, quite similar to that upon which Lieutenant Fullam writes. The "gold medal prize essay" on this subject, which is the first article in the publication above-mentioned, is by Commander J. Honner, R. N., while the "second prize essay," honorably mentioned, is by Captain S. M. Eardley-Wilmot, R. N. Both of these writers speak of the marines of the greatest naval power on earth in a manner quite at variance with Lieutenant Fullam's idea of the marines in our own service. I am so much impressed with the remarks of these officers that I quote from their articles so much as relates to marines.

From Essay of Commander Honner.

"The part played by the marines in the Navy has of late years undergone a great change. Some ten years ago the marines were considered

almost supernumerary to the complement of a ship, and instructions were laid down that, in 'quartering' the ship's company, stations were to be allotted to the marine detachment of such a nature that, on their landing, the fighting of the ship would not be materially interfered with. The small armaments, numerically speaking, carried by the ships of that period allowed this to be done. At general quarters a large proportion of the marine detachment were to be found performing small-arm exercises on the quarter-deck, others were stationed at unimportant numbers at the guns, more with the object of finding something for them to do than of necessity, for there were more than enough seamen carried to allow all the guns' crews to be formed of them. Contrast, for instance, the Minotaur's armament of those days with the present. She had then seventeen 12-ton M. L. guns. She has now the same seventeen guns, with the addition of four 4.7-inch Q. F. guns, eight 3-pounder Q. F. guns, and eleven machine guns; the complement practically remaining the same. Crews, nevertheless, with the attendant ammunition parties, have to be found for the additional guns, and if we went on board this ship at general quarters now the marines would be found, not performing small-arm exercises on the quarter-deck, but occupying as important positions as any other men in the ship; if they were withdrawn for the purpose of being landed, then some portions of the ship's armament would have to remain unmanned. What is true as to the Minotaur is perhaps more so as to the modern ships; any one who has had the task of preparing a quarter-bill knows how impossible it is to differentiate in the importance of the stations—every man in the complement has his place, and sometimes, it must be said, more than his place. The withdrawal of any men, marines or seamen, will leave a serious blank somewhere in the fighting stations. If we think of it, we must at once recognize the fact that the marine detachment forms as important a portion of the complement as a similar number of seamen would. Happily this point has not been lost sight of, for whereas in former days knowledge of naval gunnery was almost exclusively confined to the marine artillery, now the light infantry are well trained in their barracks in this respect, and the majority of them, over a certain service, qualify for the rating of trained men. The line of demarcation separating the marine artillery from the light infantry is not so broad as it was; fusion of the two branches has been mooted more than once. No doubt much might be said for this from an economical point of view, but everything must not be sacrificed to economy; if we look upon the marine artilleryman as bearing the same relation to the light infantryman as the seaman gunner does to the trained man, there is much to be said against the idea. The difference in the officers' training has to be considered, although, happily for the corps, as good gunnery officers are to be found amongst the infantry as amongst the artillery. Satisfactory as the marines of both bodies now are, it is to be hoped that under no circumstances will their sea training and experience be allowed to be less than it has been. Unfortunately, danger of this—at any rate, as affecting a large body of men—is to be feared, for owing to the dearth

of seamen which has characterized the service during the past few years, the marines forming the complements of the harbor ships have been much increased. It follows, therefore, that unless care is exercised, the sea-going experience of these men will be lessened. In the last few years a strong battalion of marines have been sent annually to Aldershot, and have, to the credit of the corps, called forth much praise for their steadiness and drill; this movement must be jealously watched by naval officers, insomuch that it is liable to divert the attention of the officers and men from the reason of their being and calling, which should be sailors first and soldiers afterwards.

"The Navy is proud of the marines, and therefore it is satisfactory to find that their numbers are almost up to the prospective requirements of the fleet. 15,363 is the strength estimated for this year, and there is no lack of recruits; it is calculated that 16,700 will be enough to form the complements of the ships built and building. A system of entering men for a period of five years to build up a reserve—which in the case of seamen and stokers might be practicable, for these latter on entering the reserve have a trade to fall back upon—cannot be applied to the marines, for the reason that to do so would be to add to the numbers of the unemployed and thus to intensify the difficulties of the Army Reserve. There is nothing for it but to keep the strength of the corps up to the limit necessary for the requirements of the fleet, trusting to the small reserve to be obtained from the pensioners' list. Unless, indeed, their strength is raised to a point, not only sufficient for the fleet, but sufficient also to provide garrisons or part garrisons for some selected coaling stations. The opinion is no doubt held by many that, inasmuch as the marines so employed would form the garrison of the station, they could not be withdrawn for purposes afloat. Granted, at the beginning of the war; but it is allowable to think that, provided the command of the sea has been obtained, part of the garrisons could be withdrawn, and it is not till then that their services would be required afloat. There is another point in favor of this plan: the opinion is held by many officers that expeditionary raids of comparatively small forces will form a prominent feature in future naval operations; now for such services as this the marines, by their duplex character, are, of all our fighting forces, the most suitable. The admiral commanding on a foreign station would be very delighted to have, say, 2000 marines at hand for such a purpose. It may also be objected that the sailor qualities of the force would deteriorate; but this could be guarded against by changing, say once a year, the detachments of the ships on the station with men taken from the garrisons. Whatever may be said on the foregoing plan for increasing the numbers of the marines, at the risk of repetition it must be again stated that the main point to be borne in mind in dealing with this corps is that the detachment borne in a ship forms an integral and inseparable portion of the combatant branch of the crew. The proportion of marines borne to the other combatant branches varies from one-fourth to one-fifth."

From Essay of Captain Eardley-Wilmot.

"I bring this corps, so long connected with the Navy, in here, because of my desire to make its officers of as much value to the Navy as the men. Far from wishing to abolish this force, I desire to see the tie between the two services made closer. How can this be done? Marine officers complain, and with justice, that after an elaborate training they are embarked, and then find little scope for their zeal and knowledge in the duties allotted to them. There is, moreover, slight prospect in the future as regards high positions after long service. They wish to belong completely to the Navy, but in ships are given little authority or responsibility. The reason for this is that their training is not naval; and the only way, it seems to me, to make the services of these officers really valuable to the Navy is to modify greatly their early career. To this end I would suggest that officers for the marine corps be recruited in the same way as naval cadets, to enter at the same age and under similar conditions, undergo the same training, and not branch off to the special line of marines until their naval training is complete. Then when the naval sub-lieutenant goes to Greenwich the marine candidate would also go there, and study certain special subjects, eventually going into barracks for company and battalion drill. In the French naval organization there is a school of musketry at Lorient, in which officers qualify as 'fusilier' lieutenant. The course is five months, and on completion these lieutenants are appointed to large ships for what we may call small-arm duties. These are in connection with the special 'mousquetaire' branch of seamen who qualify at Lorient as 'fusiliers'—independent of gunnery and torpedo—and form the landing companies on board ship.

"My idea is that our marines should be analogous to this corps, and the officers take similar duties. Their naval training would also enable them to be utilized for other work on board. Instructed in navigation, and having taken part in the general routine of a ship, they would be qualified to take charge of a watch. Their uniform should be adapted to the distinctly naval functions they would assume. It is now purely military, an innovation which is comparatively modern.

"There can be no question that under the foregoing conditions blue should be the universal color for naval service in all naval branches, and stripes on sleeves indicate grade in place of elaborate braid ornamentation. This could be effected without altogether obliterating the special characteristics of a marine corps.

"There is another aspect of this question in which a close approximation of marine to naval officers may commend itself at a time when the list of the latter, as regards lieutenants, barely provides sufficient of these officers for ordinary requirements. It is that with the changes advocated we should possess practically additional executive officers, and in each ship supplement the lieutenants by one able to assume functions of which, hitherto, he has only been a spectator.

"It is impossible within the limits of this essay, dealing with so many important subjects, to present such a change in more than outline. It

is important enough, however, to be referred to a joint committee of naval and marine officers, who, accepting the great principle of cementing and drawing closer the connection between two bodies which long service in the British Navy has linked together, shall find the means of making still more useful that corps which has ever been proud of the connection.

" In making these suggestions, I wish it to be clearly understood that I do not seek to destroy the individuality of the force as marines. Their traditions are too marked, and their services so much appreciated, that few would desire to see these obliterated by simple absorption into the Navy. They themselves would not welcome any such radical change. But if the higher grades are retained as now, there must be more to look forward to than at present, and these should be found in home ports as well as stations abroad. There are many important commands in places dependent on the Navy which might well be filled by colonels and generals of marines. It can hardly be said that the Navy has its fair share of positions of responsibility in outlying parts of the empire. The fitness of the marine officer, with his dual training and knowledge of fleets, for such positions can hardly be questioned. Practical recognition of this in the future, with adoption of my suggestions for the earlier portion of his career, would remove all discontent, in addition to proving beneficial to the State."

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NAVAL WAR COLLEGE.

CLOSING ADDRESS, SESSION OF 1895.

By CAPTAIN H. C. TAYLOR, U. S. Navy,
President of Naval War College.

Gentlemen:

We are now about to close the session of 1895 at the Naval War College. The College has not been long established, and during these, its early years, our sessions have been avowedly tentative in their nature. It has been our wish to discover, through actual experiment, whether the Navy desired these methods, whether it felt in itself any disposition toward the study of war. I have never doubted that the Navy would know, better than any one could tell it, what its professional needs were in any special case, if its attention could once be seriously drawn in that direction. An ancient maxim says that when a man has reached the age of forty he is either his own best doctor or a fool. Similarly it may be announced as probable that an organized system, such as the Navy, with a century of growth and experience to form its opinions and generate its intuitions, will have a clearer knowledge of what is good for it than can any individual suggestor, whether he be himself within or without the ranks of the naval profession. To insure this clear knowledge and intuitive perception on the part of the naval organization, it is of course a prime necessity that its attention, attracted in turn as it is to the many new and strange things of modern times, should be concentrated for a time at least upon this somewhat neglected art of war. Once thus concentrated, we may count upon a worthy decision, representing as it does a consensus of intelligent minds, able to judge and

faithful in judging; lending its weight to that maxim of the politicians that " Every one knows more than any one."

The attitude of the College toward this matter is therefore that of one who, having submitted certain questions to a court and produced varied evidence for both sides, awaits with patience the decision of the judge. In this case the Navy is the judge, and will in time render a just verdict; but the College, though it will await the decision with patience, does not profess indifference as to the result, but on the contrary announces itself as an earnest believer in the study of warfare as immediately and critically necessary to ensure the credit of the Navy and the reputation of the Republic in the wars that are to come. We refer to the history of nations and of their armies and navies for absolute proof that this critical need exists. Their records show convincingly that the neglect of the art of war renders useless or destroys the bravest troops, the best equipped fleets. No one claims that the Germans who conquered France in 1870 were a different race from those Germans who were swept from the map of Europe as a military factor in the early years of the century, and by those same Frenchmen or their fathers. Clausewitz, and after him, Moltke, perceived that earnest study of warfare, laborious preparation for war, were the natural solutions of this problem, the main factors of success in this trade of war, as in all trades. They undertook the task bravely and patiently. Much patience was needed, we know. The remnants of a feudal system with the ghost of an old-time chivalry were banded together against them. It was rank heresy, their opponents claimed, to say that there was anything in war but bravery and loyalty, especially anything so lowering as work and study—study of their own hills and rivers, of the territory of possible enemies, of their war resources, and finally of the history of former campaigns. War was represented in their minds by their good swords, their steeds, their own valor and fidelity. This was all—there was nothing more. So away with pedants and their dusty histories and laborious preparation! The new school of officers could, however, point to the then recent annihilation of the Prussian armies by the brilliant Corsican, and to this there was no answer ready; and so the new ideas prevailed, and were consummated after a half-century at Königgratz and Sedan.

We of the present day, looking back as from a height upon the century now closing, so full of impressive military lessons, possess an advantage that cannot be overestimated, and that should not, and I believe will not, be neglected by our nation. We cannot fail to recognize in the great example set by Prussia the overwhelming weight of study and thought in war; though that country delayed until it was driven into this system by the menace of speedy effacement from the map of Europe. The question for us is whether we shall also wait until war having come, some national humiliation teaches us the bitter lesson that Prussia learned in loss and sorrow. It is not a question now of a large or small Navy, but how we will some day use whatever force may be placed in our hands. Eight of our ships well handled and bravely fought, but beaten by twelve of an enemy—this will bring no shame to our people; but should the day come when twelve of ours, through lack of officers trained for war, are defeated by eight of an enemy, then will a blow have been struck at our national pride, and the bonds of sentiment which alone hold together the different portions of our country will be that much weakened and more likely to break under pressure when the disrupting forces, to which all nations are at times liable, shall be exerted to divide the continent into several distinct nations. We can endure defeat if discreditable no better than other races. What they may dread in loss of territory given up to their conquerors, we have to fear in the shape of a weakening national sentiment tending some day to disintegration of the body politic.

As to the material and men provided, no thinking man among naval officers would advocate great armies and navies for our Republic. The force provided, the ships, the weapons, and the personnel should undoubtedly be of small though reasonable size, but there is an eternal fitness of things which must be considered. There goes to the making of a great nation, or a complete one even if not great, certain elements which enter in due proportion into its composition, and no one of them can be omitted or slighted without marring the appearance and the strength of the whole. There must be so much commerce and money-getting, so much of governmental protection, so much of legislation, of judiciary, of revenue, of expenditure. With these and many other elements there must be

a proper proportion of military force for protection against enemies, for strengthening the other arms of the government, and in addition to stand as a type and embodiment of that spirit of national pride and aggressiveness which, although decried by some, nevertheless exists as an inextinguishable trait in individuals and aggregations of the human race. To preserve this due proportion of the elements of a nation its leaders should strive; and if 25,000 troops and 8,000 seamen was a fitting peace establishment a generation ago, and if since then the nation has passed from infancy to youth, or from youth to prime, and has gone forward enormously, not alone in commerce and manufacture, in railroads and telegraphs, but in a certain elevation and expansion in the spirit of the race; then let us not hesitate to increase the military force afloat and ashore to such an extent that its relation may be a true one to the rest of the body politic and that the national edifice may be strong and symmetrical. My object is to impress the fact upon all that hear me, that armies and navies exist not alone for war, though war is their supreme function, but in order to make round and complete the national life and to fulfill one of the structural requirements of the political edifice. We know not why this should be one of its requirements, but we do know that the fact exists. The records of history supply evidence of this; nor is there an exception to be noted in all time. Nations that are over-warlike and too little commercial fade and weaken, and if they do not correct the defect they soon pass away. Similarly nations which make a god of their commerce and money-getting and neglect the military spirit, pass likewise from among the group of competing nations. All the elements must be in proportion in order to ensure successful development and healthy life. I reiterate that this is not only because armies fight battles and win campaigns—that is, I confess, their most important occupation—but they exist primarily because needed as a component part of the organism which when completely developed is called a nation. This organism must clothe itself and feed itself, must in one way or another govern itself, and must by the laws of its existence sometimes engage in wars. This being acknowledged—and it is but a matter of history we are now presenting—it is much to our country's interest that our Army and Navy should undergo a slow but steady

increase in its force, and that this force should keep step as far as possible with the expansion of the nation, its spiritual as well as its material expansion. Nor need we fear that the discernment of the American race will fail in this instance to recognize the instinctive demands of its national life and to require of its government a reasonable increase of its military force afloat and ashore. Here the War College is peculiarly interested. This expansion of our military forces must carry with it all the necessary accompaniments and accessories of a military development; lacking any of them, the attempted step upward may be a stumble, and the resulting fall delay our onward progress upon the stairway of nations, and perhaps bar it forever.

In this material military expansion, the essential point is that the people who are to handle and control the increased force should understand the needs of their profession. There are many of us in the navies of to-day who, having known no great naval wars in our own time, nor in the generation immediately preceding us, fail to appreciate the urgent need of the study of war in all its phases, and we feel, and justly so, that we are expert in our calling as it is at present known. We say very truly that we have sailed ships, fired guns and commanded men, that we know how to do these things well and that there is nothing else of grave import in the art of war. I am told that in a greater or less degree this holds good of the officers in many of the modern armies of to-day. This was not always so. There was a time when, although the world had not advanced so far in what it calls civilization and enlightenment, men of intelligence recognized the existence of the art of war. In the old days, young gentlemen of good families, who were destined for the higher places of the world, after they had learned the use of the sword and lance, the control of a horse, and had studied some of Caesar's campaigns, were sent to "the wars," there to gain an experience that was, with reason, regarded as a necessity for youths upon whom were in time to devolve the duties of leadership and the conduct of campaigns. They profited by this experience in varying degree; some learned to command their men and to care for their horses; others, of higher intelligence, scanning attentively the fields of conflict, gained some expertness in tactical dispositions and some acquaintance with the principles of battle formations; while

a few rare minds, penetrating the confusion of marches and skirmishes, divined the plans of great captains and recognized the far-reaching effects of strategic combinations. But to all there came some measure of that knowledge which only practice can give, and from their minds surely faded those dreams of war which we dream only in profound peace. Those days have passed. Fighting as a profession, except to defend one's country, has come to be thought more or less immoral; nor are there always convenient wars to serve as schools for youths of military inclinations. Yet wars, alas! have not altogether ceased, and we must still learn something of warfare or submit sooner or later to the nation's humiliation.

I fear to have wearied your patience. I do not think that these, my foregoing remarks, are needed to convince your minds, but it will have done no harm to recite in their proper sequence the various circumstances which go to make the study of the art of war proper for those whose profession is that of arms. This being conceded, let us consider whether here at this school of war we are following the methods most likely to attain this desired knowledge.

The system followed is known to you. Its idea is to place officers of experience in such an environment, mental and professional, as shall make it easy and natural for them to bring the powers of their minds and the wealth of their experience to bear upon questions of war, and then to await what seems to be the natural and inevitable result, namely, that those officers will become engrossed in this most fitting professional work and thus ensure valuable suggestions as to naval warfare, and a willing study of the art through extensive reading carried on here and after leaving the College, and a freshened interest and quickened apprehension of the lectures delivered during the session. It is the governing principle of the system to encourage the creative faculty in the minds of the officers in matters concerning warfare, and to dispel that passive condition of receptivity which, as I had occasion to say last year in the closing address, is to be expected in a profession of arms which, at the end of a long peace of thirty years, has become much affected in its reasoning processes by an established routine, long-contiued and unbroken.

The war problems have been continued and again excite keen

interest. These problems and the strategic war games develop high professional qualities, but it was observed during last session that the development was principally of the deliberative qualities of the mind. There were occasions in the strategic war games when, after days of preliminary planning, officers, confronted during the game with some unexpected development of the enemy's force, demurred at being obliged in a few minutes to readjust their plans to meet the emergency. It was to prevent that deliberative quality, in itself so valuable, from being carried to excess that there has been introduced in this session the consideration of naval tactical situations. These situations, to which we gave much attention during the first half of this session, and which as you know were based as to their methods upon the tactical situations placed before the German army officers by Von Moltke and others, have, I believe, succeeded in gaining your approval, and I wish to record my opinion of them as a most effective means of developing in our minds a thorough apprehension of the art of war. One of the many defects for which a long peace is responsible is this over-deliberation, this lack of readiness to attack the problems of war at first sight, and it can only be dispelled, I believe, by frequently recurring presentation of these tactical problems to the naval mind. It will give us pleasure at the College, as we prosecute this branch of work, to send from time to time to all officers interested, such situations as seem most worthy and likely to excite professional interest.

Of the War Charts and Defense Plans nothing new need be said. The great value of this work has been previously shown and is confirmed by the present session, and I need not urge further upon your attention their importance in case of sudden war. This consideration is outside of their value as an exercise for the mind in the study of war; for this purpose they were undertaken and will be carried on, but it is not to be denied that their intrinsic value in case of war is very great, for we will then have but few days or weeks allowed us for preparation. These charts will represent years in their construction; and, when placed in the hands of an admiral and his staff already overburdened with the hurry and responsibility of sudden emergency, will be welcomed most heartily as a valuable accessory in the campaign. They need not hamper nor retard a com-

mander-in-chief's plans, for it will be a simple matter, if that officer does not approve of them, to throw them to one side and invent his own; but it will often be the case that the time will not allow the formulating of new plans, and that these war charts, the result of patient work and intelligent study, may be of inestimable value to our fleet in a moment of crisis.

Among other exercises the single-ship game has been improved, while the tactical game has advanced far towards that effectiveness which the College finally expects it to attain. The strategic game continues its hold upon the attention and teaches us many lessons concerning naval warfare on our coast and in the Caribbean Sea.

The use of the launches has not been as full and effective as the College had hoped. The President of the College wishes, however, to record his unaltered conviction that much of great service to us will be learned from them. Last year we undertook some ramming experiments; this year we have tried on a few occasions to manœuvre to keep the enemy under our most effective fire. I desire to quote in this connection from Admiral Ito, who prepared himself and his captains before his successful battle, by exercises with launches.

"I then equipped," he says, "the steam launches of the various men-of-war in such a way as to ensure them against severe damage in case of collision, and then divided them into two parties, imaginary squadrons, and appointed the two senior officers as the commander of each party respectively, and with them then we practiced sham fighting. This form of drill is very apt to become half a pleasure, and as a matter of fact in a very short time every boat in the sham squadrons began to evince an inclination to try the ram, as they were all well protected against damage in case of collision. Seeing this, I called a meeting of the commanders of all the boats and cautioned them against any such child's play, pointing out to them that all the vessels we were commanding were not ironclads and were therefore not suited for ramming. We then set about training so as to avoid any mistakes of actual collision. I ordered all to drill as if they were engaged in actual combat. After this the tone of their tactics became greatly improved, and all began to manœuvre carefully with a view to avoiding running into each other. This drill was continued until July 23d, when we re-

ceived an order to proceed to Chemulpo, and moved accordingly."

It is left to speak of the lectures, but time will not permit me to mention the many able officers who have addressed us. You will justify me, however, in making an exception of Captain Mahan, from whom we have had two series upon strategy. You have enjoyed with me the power of his mind, the clearness of his military and naval ideas, and the polished directness of his literary style. I need not dwell upon the work of this distinguished officer. I know that I speak for you as well as myself in saying that his lectures and books have poured a flood of light upon the great problems with which we have striven during the last five months. It will be difficult to go wrong in professional questions while we are guided by his wise advice and instruction.

These, gentlemen, have been, in brief, the methods which we have followed in endeavoring to promote the study of the art of war, and in closing I can only repeat to you my words of last year:

"What shall we say, then, in summing up the results of the course? What do *you* say?—for it is not so much what the College says, or what its President may think in his hopeful moments, that is to weigh most heavily in the future. It is what you shall say, officers most of you of long and varied naval experience, that is to constitute the most potent factor in the College future. It is the news that you carry back with you to your ships and stations which is to influence the opinions of our comrades throughout the service and cause them to think and speak for or against the continuance of the College. It must be finally for the Navy to decide whether it wants a school of war or not. If a large majority of the officers wish it and express that opinion strongly, I do not doubt that it will be continued. And on the other hand, if the Navy does not want it, let us not spend our strength in useless striving to give the Navy what the Navy does not want. Only, first of all, let officers know what this thing is that they are to approve or reject. Let them understand what this school of warfare is, what its methods, what its aims, and this they will best learn from the officers present."

I ask you then to speak in no uncertain voice of the College

work. Let there be no indifference, let it be strongly blamed or heartily praised. Believe me, gentlemen, if it be not thoroughly worthy it should be quickly condemned and done away with; but if on the other hand it be the very good thing that some of us believe, and critically important to us and the generation of seamen that is to follow us, then I beg of you to speak boldly and plainly, that we may not falter in the work that is before us.

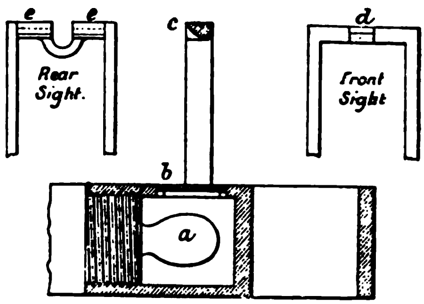
PROFESSIONAL NOTES.

SIGHTS FOR ORDNANCE.

[ENGINEERING.]

During recent years immense advances have been made in the construction of rifled ordnance, and even more markedly in the manufacture of powders for the same. The much-abused cordite has given wonderful results as to uniformity, and it is related on good authority that on one occasion three successive 100-lb. shells were sent through the same hole at a range of 1000 yards. This, no doubt, was to a certain extent a fluke, but is, nevertheless, an excellent testimony to the ability of the gun crew and the quality of the material. The construction of gun sights has not, however, altogether kept pace with the advances in other directions, and the old simple notch sight is still in general use, and, in spite of its crudeness, the results obtained are astonishingly good. Nevertheless it has long been recognized that a telescopic sight, if so constructed as to stand the hard usage to which it must necessarily be subjected in actual warfare, would have great advantages. The principal difficulty has been to construct a telescope sight in such a manner that it can be left on the gun during the firing, which has many obvious advantages. The fittings must accordingly be strong enough to withstand without injury the jerk arising from the recoil. A telescopic sight has been introduced by Captain Grenfell, of 39 Victoria Street, Westminster, and has successfully undergone severe trials in France. It consists of an ordinary theodolite telescope mounted on a curved rack, passing through a sleeve rigidly secured to the gun. This rack is of hardened steel and of channel section, and has accordingly great rigidity for its weight. The most severe tests of its rigidity were made by running the telescope up to its highest point, in which position the jerk of recoil will, of course, bring the most severe bending strains on the rack, and firing the gun with full charges. This ordeal was successfully passed through. In dull weather the telescope is of little use, as light is lacking, and hence in all cases an ordinary sight must be fitted as a standby. In this case the ordinary sight consists of a set of cross-wires fixed at one side of the telescope, near its object-glass, whilst near the eyepiece an iris diaphragm is fitted, and the sighting is effected by placing the eye to the orifice in the diaphragm and aligning the cross-wires on the mark. It should be stated that in no case is the line of sight parallel to the bore of the gun. This is owing to the fact that the shots from a rifled gun have a lateral drift, allowance for which is made by tilting the line of sight an equal amount in the other direction. Another difficulty to be overcome in the matter of sighting is the reading of the range scales, the divisions towards the upper end of the scale being exceedingly minute. An open reading scale has obviously great

advantages, and to secure this Captain Grenfell has adopted the ingenious plan of engraving the scale on a strip of phosphor bronze some 10 feet long. This strip is coiled round a couple of rollers, connected by gearing with the telescope rack. One of these rollers is spring mounted, so that any slack between the two rollers is automatically taken up. In this way the dimensions of the scale are greatly magnified, and the ranges can be engraved on it in plain figures. The necessary horizontal deflection for wind allowance is obtained by means of a tangent motion by which the telescope can be rotated in a horizontal plane. In the French trials this sight gave excellent results, although the gun crew had had no previous training in its use.



At night all the usual methods of sighting become difficult, and many attempts have been made to simplify matters, such as by touching the front sight by luminous paint, throwing the light of a lamp on it, etc., but the method now generally adopted in the navies of the world is due to Captain Grenfell, and is shown diagrammatically in the figure. The device consists of two fittings, one of which can be secured to the front and the other to the rear sight. Each of these fittings is arranged to receive a small incandescent lamp *a*, the light from which is reflected through a window at *b*, which is of red glass in the case of the rear sight, and of white glass in that of the front sight. This light striking on a curved surface at *c*, which is polished and of a non-corrodible metal, is seen by No. 1 of the gun as a bright horizontal line. The curved polished surface, in the case of the front sight, is confined to the central part of the stirrup as shown on the right at *d*, whilst in the case of the back sight a notch is cut in the stirrup through which the front sight can be seen, whilst on each side the light of the lamp is reflected as a red horizontal line from the two polished surfaces *e*, *e*. The appearance in aiming is, therefore, a white horizontal line between two red ones. When the three are in one straight line and at the same time the middle line is bisected by the mark, the gun is truly aligned, both for direction and elevation. A switchboard connects the lamps to the source of current. Mounted on this switchboard are two rheostats, by means of which the intensity of the light is controlled. By operating one of these, the relative brightness of the two sights can be adjusted to each other. This done, the second rheostat is used to vary the brightness of the two lamps uniformly, until both the sights and the object aimed at can be clearly seen at the same time. In a still more recent form of this

sight Captain Grenfell has added a third switch, by which a small hand lamp can be coupled up with the board. This lamp is used for reading the range scale.

DEVICE FOR MINIMIZING THE EFFECTS OF COLLISIONS AT SEA.

[EXTRACT OF ADDRESS DELIVERED AT GENERAL CHAMBER OF COMMERCE, HONGKONG.]

By REAR ADMIRAL S. MAKAROFF, Imperial Russian Navy.

Mr. McConachie and Gentlemen.—I need not tell you that collisions are very frequent in these days. I have no statistics, but every one reading one of the big morning newspapers finds there almost every day some information about collisions at sea and their fatal consequences. In some cases the newspapers give different details; but more often the report is very brief and simply states that such and such a ship went to the bottom and so many lives were lost. Every one of us is so much accustomed to read such information that we do not ask ourselves whether it is really unavoidable that, after the collision, one ship or both of them should go to the bottom. It is taken for granted that from time to time ships collide and sink, and I believe this sort of information produces less impression upon us than some trifling political news. From time to time a court of inquiry or court-martial investigates the details of the collision, but it is certain that the court will study chiefly the question as to who is responsible for the collision, and very little notice is generally taken of the reason why, after collision, a ship goes to the bottom. Shipbuilders tell us that ships are divided by the water-tight bulkheads, and that the buoyancy is sufficient to keep a vessel afloat should one of the compartments be filled with water. Generally, when collisions occur there is nobody to accurately record the details, and as a rule it is taken for granted that the collision took place at the bulkhead, and for this reason two big compartments were filled with water. Maybe it will also be suggested that one of the bulkheads could not stand such an immense pressure and gave way at the critical moment. Formerly collisions were not so fatal, as sailing ships, which are usually constructed with a fiddle bow, have bowsprit and so much rigging in front that the effect of a collision is of course minimized. It is also necessary to mention that in the old days the speed of ships was very much less than it is now, and that the ships were mostly of wood, which resists more effectively than the thin plates of steel used at the present day. A fiddle bow usually damaged only the upper part of the ship, and before the water-line could be reached the force of the blow had spent itself. The ships of to-day travel at a high rate of speed; they have great displacement, and their vertical bow is so strong and so sharp that the moment collision takes place the skin of the ship is penetrated from the gunwale to the water-line, and an immense rush of water into the vessel is the result. Let us go into the details of the collision so that we can ascertain whether any remedies can be applied to lessen the danger. I shall try to be as brief as possible, but in order that you should better understand, let us look at the matter from every point of view. The first and best

remedy which one can propose is to avoid a collision altogether, and certainly every improvement in the rules of navigation is very important, but the conditions under which seamen have to navigate are sometimes so difficult that it is perfectly certain that collisions will take place in future, notwithstanding any rules that may be proposed in order to make navigation as safe as possible. The second remedy is to minimize the effect of collisions, and on this point I shall speak afterwards in detail. The third remedy is to have water-tight bulkheads, so well disposed and so strongly built that they should localize the inflow of water. It was at the beginning of my service that I commenced to study this question, and something was done in the Russian navy to make the bulkheads more efficient. I shall not trouble you with the details of this most important branch of shipbuilding, but I venture to lay before you one single proposition which, in my opinion, will produce a great improvement in this matter. I wish to draw your attention to the fact that everything on board a ship is tested before she is taken from the hands of the shipbuilder. Capstans, rudder, engines, cranes, winches—everything in fact is tested in order to ensure that the whole of the fittings are quite sound and capable of performing the work they are meant for. Water-tight bulkheads are excluded from this examination. If you ask a shipbuilder if he tried the bulkheads he will answer "Yes"; and he is perfectly right, because he is obliged to test them with the fire hose. If, after collision, bulkheads were not subjected to a more severe trial of their strength, then of course it would be all right, but unfortunately, when a compartment is filled with water the pressure which the bulkhead is subjected to is very heavy, and I think the only way to be absolutely certain of the strength of the bulkheads is to try them under similar conditions to those in which they will be after the compartment is filled with water. Allow me to give you an example. Now only few manufacturers know how to make guns strong enough to resist the immense pressure of powder, and nobody dare make a gun with inferior metal, for the simple reason that every gun is put to a very severe trial before it is taken from the hands of the makers. If this condition were not insisted upon anybody could make a gun which would resemble the very best specimen, but it is certain that the first time the gun was fired it would be blown to pieces. If we cannot accept guns, capstans, winches, etc., without trial, why then do we accept bulkheads without trial? I propose that when a ship has been fitted with engines, boilers, water-tight doors, and everything else which cannot be damaged by water, a trial of the bulkheads should take place by filling the compartments with fresh water to the upper part of the bulkheads. This trial ought to be made in the presence of competent officials, who should certify that the bulkheads are strong enough to withstand the full pressure of water, and that they are water-tight. This trial over, the boilers, cylinders, pipes, etc., can then be covered with the usual non-conducting composition and the cabin fittings put in their proper place. Probably all this work will occupy a week or so, but the loss of time will be amply compensated for by the ship being guaranteed absolutely trustworthy in this respect. If the collision takes place upon one of the main bulkheads, two compartments are filled with water. In order to avoid this I propose that each main bulkhead should be supplied with extra small water-tight compartments at the side of the ship, from ten to twelve feet wide. Then the collision would only affect one bulkhead of these small com-

partments, and the result would be that instead of two big compartments being filled with water, only one big compartment and the little one would be flooded.

The fourth remedy for preserving the safety of the ship consists of a means whereby leaking may be stopped. Twenty-five years ago I proposed the use of collision mats; one of them was exhibited at the Vienna Exhibition and every man-of-war of every nation has them now. Lately I have improved this apparatus, but although they are invaluable on men-of-war, I do not think they will be ever accepted for merchant ships, because in order to use them to advantage the crew must be regularly drilled. I do not say the mats are useless for commercial ships, but there are now more important improvements which have prior claims to our attention. Now I return to the second remedy. The general opinion is that the colliding blow is so very powerful that nothing can minimize the effect of it; but I can give proofs that even when the force of the blow is comparatively slight the skin of the ship is penetrated. It is a matter of fact that the vertical stem acts as a knife and that very little energy is required to penetrate the skin of the ship which is run into. We know, for instance, that the Crathie, the steamer which sank the big ocean liner Elbe, was of very small dimensions, and struck when she was going at a very moderate rate of speed. Everybody knows that the Elbe went to the bottom in a very short space of time and only a few of the passengers and crew were saved. I was a witness of a similar case in the Bosphorus. A Russian steamer, Azove, touched a big French mail steamer, the Provence. The speed of the Azove at the moment of collision was not more than two or three knots, but her stem made a hole in the skin of the Provence, and the latter immediately went to the bottom. I may give another example which occurred less than a year ago, also in my presence, in the harbor of Chefoo, when a torpedo catcher of 400 tons displacement and of a very slight construction touched the cruiser Pamiat Azova, and although the stem of the torpedo-catcher was of very delicate construction, the hole made was big enough to permit of the entrance of a tall man. Had there been no belt of armor at the water-line an immense rush of water into the vessel would have followed. It is a known fact that two years ago a torpedo-boat of 70 tons displacement went into a man-of-war and the skin of the latter was penetrated. I believe the examples which I have given are sufficient to prove that, however slight the blow is, the skin of the ship collided with is of a certainty damaged, and a rush of water follows. It is believed that nothing can be done to minimize the effect of collisions because the blows are so very heavy, but this does not mean that nothing can be done in case of only a slight shock. I may give an example which will prove that two ships may collide without damage being sustained by either. Thirty years ago Admiral Boutakoff wished to give his captains the opportunity of ramming exercise. Two gunboats of 300 tons were employed for this purpose, and each boat was entirely surrounded by a huge fender two feet in diameter, made of very light trees and branches bound firmly together so as to present a yielding shield. This protection was sufficient to preserve the one vessel intact when rammed by the other. It is true that the speed of the vessels was never higher than six knots, but I saw myself that the concussion at the moment of ramming was so great that not one of the men on board could keep his feet. This proves that from the moment one ship touched the other to the

moment when the vessel was stopped the colliding ship made a progress of maybe only one foot. But in the case of the Pamiat Azova the crew of the torpedo-catcher were not in the least affected by the force of the blow. This shows that the resistance of the ship's side when the skin is penetrated is very small in comparison with the resistance of the skin before penetration. Is there not a striking difference in the result of the two cases I have just mentioned? While in one case the ships continued their practice as if nothing had happened, in the other the damage was very great, and if the Elbe had been in the place of the Pamiat Azova she would have gone to the bottom. In order to demonstrate the difference between touching the skin with a ram which is without a buffer and a ram with a buffer I made some experiments a few weeks ago on board my flagship Emperor Nicholai. Vice-Admiral Buller, Rear-Admiral Hoffman, Commodore Boyes, and many captains were invited to witness them. A model representing a ramming vessel was moved by a weight so as to ram a model which represented the amidship section of a ship. A small buffer of a quarter of an inch thickness of cotton cloth was made which could be adjusted to the ram. When the blow was dealt without the buffer the ram easily penetrated the skin of the other model, and the ramming vessel made an inroad of three-quarters of an inch and cut a hole two inches in length, which in reality means eight feet. When a similar experiment was made with the buffer on the ram an inroad of only a quarter of an inch was sufficient to arrest the progress of the vessel, and the skin was only slightly bent and not penetrated. This experiment is analogous with what happened in the two before-mentioned cases. It shows that the model experiments, if properly carried out, are very useful in testing the application of new improvements. Does it not also show that something can be done to minimize the effect of collision? What is the reason, then, that up to now nothing has been done to minimize the effect of collision? We see improvements in every branch of shipbuilding. Why, then, is such an important item as this left without due attention? There is something which interferes with this most necessary improvement. I believe I shall not hurt anybody's feelings if I say that the main reason why ships are not improved in this way is the false supposition that they cannot be improved. I believe this is really due to prejudice; at any rate no scientist has yet proved this supposition. It is everybody's fault that this prejudice exists. *Quand tout le monde a tort tout le monde a raison.* Where there is a prejudice there is no progress, and the first thing that we have to do is to remove the prejudice. As soon as we believe that ships can be improved in the desired way they will be improved in a very short time. It is taken for granted that the energy of a blow which is developed by one ship striking another is so very great that no means can be devised to absorb it without injuring the ship's skin. Let us see if this is so. A big ironclad of 10,000 tons ramming at five knots speed gives a striking blow of 15,000 foot-tons, while the muzzle energy of one 12-inch projectile is 20,000 foot-tons. You know very well when you propel the projectile with this energy one way the gun and the carriage are thrown with the very same energy into the opposite direction. Should nothing be arranged to withstand this blow a lot of damage would necessarily follow. But hydraulic buffers easily absorb this energy in a space of two feet, and really the shock is scarcely felt on board the ship. If it was a question of absorbing the energy of the big ironclad

striking perpendicularly on some firm solid block strong enough to receive that blow, then an ordinary 12-inch gun's buffer fixed on the ram would take the whole energy of the 10,000-ton ship striking at the speed of five knots. This example shows that the energy of the blow is not so very enormous. Generally speaking, a collision never occurs when the boats are going full speed. Engines are always reversed before the collision takes place and that diminishes the speed considerably. Experiments show us that if the biggest ship in the world was going at full speed ahead she could be brought to rest three minutes after the engines are reversed from full speed ahead to full speed astern. I have pointed out that the skin of the ship struck is penetrated because of the hatchet-like action of the stem of the striking vessel. Should the fore part of the ship be flat, the skin of the ship collided with would be battered in, but not broken. The effect of the collision would be damage more or less serious, but there would be no hole in the skin. Certainly, it is impossible to build a ship with a flat nose, because such a ship could not be easily propelled, and besides, if we make the fore part of the ship flat we should be safe only when the blow was perpendicular. In order to show the difference of the effect of the sharp bow and the flat bow, allow me to give you the following example. Suppose I see the chairman in danger and I wish to move him in order to save him. If I try to move him by pressing him with the point of a sharp knife I am sure to kill or at least to wound him before the force of my blow sends him backward. Now suppose I push him with the flat of my hand. He will be neither wounded nor killed; he will simply be moved from his place. This clearly shows that the solution of the problem is to build a ship in such a way that her fore part should be sharp while she is propelled through the water, but that at the moment the nose of the ship touches the skin of another her fore part should collapse and present a flat surface. The power of the shock will consequently be distributed over a wide surface of the skin, bending inside ribs, beams, etc., without making a hole in the skin. Some part of the power of the shock will be exerted in collapsing the fore part of the colliding ship, and if this part is designed properly the collapse will absorb the greater portion of the blow. It would be almost desirable that at the moment of touching the false nose should begin collapsing before the skin of the other ship begins to give way. The force required for collapsing should increase with the progress of this collapse, because more surface of the striking ship is engaged in resisting the shock—maybe it will be possible to altogether avoid damage to the vessel which is struck by so arranging the false nose that the full power of the shock will be utilized for smashing this nose. By that time the ship which strikes will lose the greater part of her speed, and the other will recede in a corresponding manner. Let us examine the question whether ships can be provided with a false nose strong enough to resist the effect of the sea and weak enough to give way at the moment of collision. I feel that engineers whom I see in this audience are more expert than I to decide this question. If I venture to propose something it is for the simple reason that I wish to exchange ideas upon the subject in order to arrive at a proper conclusion. Let us imagine that the nose of the ship is built as usual, and that the false nose is an additional part which can be put on or taken off when necessary. I imagine that it ought to consist of very thin sheets of steel, say one-eighth of an inch, and should run in front of the

ship, as shown in figure 1. Many little ribs and stays inside ought to give enough strength to the skin to enable it to resist the force of the waves. The space between the false shell and the nose of the ship ought to be filled with some soft, fibrous substance (not powder). This substance is intended to play the rôle of a cushion and the shell will play the rôle of a pillow-case. After collision the false nose will present the appearance as shown in figure 3. The ship's nose will not be damaged, and as generally there is no cargo in the fore compartment of the ship in front of the collision bulkhead, it will be the work of a few hours to unfasten the bolts and remove the smashed false nose in order that the ship may continue her voyage as if nothing had happened. I believe that it is necessary to carry on experiments on a large scale in order to find out which is the best way of constructing the false nose

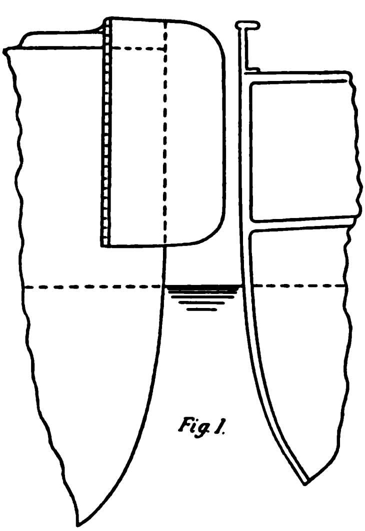


Fig. 1.

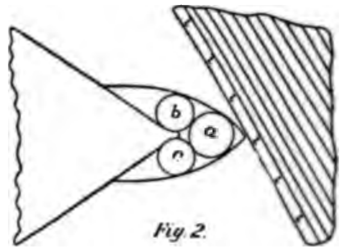


Fig. 2.

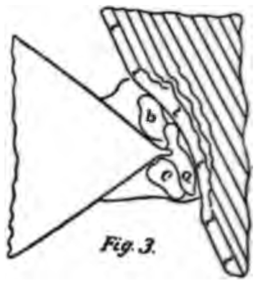


Fig. 3.

of the ship. The cost of these experiments will amount to only a trifling percentage of the loss which is being continually caused by collisions. Let the best engineers work out their plans and submit them to experts for examination. After this a general law might be passed making it compulsory for every ship to be provided with a false nose. Unfortunately in this matter everybody is interested in a general manner, but nobody in particular. Insurance companies prefer to be liberal, and they do not interfere much with the particulars of the building of a ship. They are obliged for a certain percentage to guarantee any risk. If one insurance company insists upon shipowners providing ships with a false nose, then surely the number of the company's clients will diminish, and that will be followed by a diminution of the company's income. Now should one shipowner put a false nose on his ships he would lose, because the false nose would weigh about two tons and cost about £200, and for this reason his ships would be dearer than the ships of his competitors and carry less cargo. The reasons mentioned before interfere very much

with the furtherance of this improvement Only public opinion can give an effective incentive to the matter, and really if by subscriptions a fund can be raised and given to the Board of Trade or to any institution which will carry on the necessary experiments, then progress is bound to follow. We are not bound to decide the question in a moment, but every one should be reminded that the loss of property from collision is immense, and that almost every day many lives are lost, owing to the absence of any means to minimize the effect of collision at sea.

IMPROVEMENT IN WAR MATERIAL.

Reviewing the development of war material during the year 1895 the "Engineer" says: "The efficiency of quick-fire depends on the use of smokeless powder, and we may congratulate ourselves that while cordite has given us much trouble in manufacture, the finished article as issued for service has so far proved itself thoroughly stable and safe under the most trying conditions, while it has given excellent ballistic results; in fact, to say that it has established its character as thoroughly, probably more thoroughly than any other smokeless powder, is hardly to do justice to it. On the continent smokeless powders, chiefly based, like cordite, on the combination of nitro-glycerine and cotton, are used, but in the United States, strange to say, so great is the distrust of such powders that nothing better than a semi-smokeless powder of unsatisfactory behavior has been allowed to be used on board ship. On the other hand, the U. S. Navy have been forward to adopt high explosive bursting charges for their shells; recent experiments, however, instituted owing to reports from the seat of the Chinese and Japanese war, showed that powder produced greater effect than wet gun-cotton, and it is anticipated that powder will be reverted to in America.

"Passing on to armor, we find the United States, far from lagging behind, is here in the very front of the race of progress. In the United States a really good nickel treated plate will defeat a Holtzer 6-in. projectile. Till our treated plates do the same we are apparently left behind. Then, while we seldom test really thick treated plates, the United States authorities do so and have achieved most striking success with them, especially with what are called 'double forged' plates made by Carnegie. Double forging is the natural remedy for crystallization and weakness produced in very thick plates by the Harvey process, but double forging is untried in this country. At length, however, we are glad to hear that our armor-plate manufacturers are alive to what has been done abroad and are making efforts to push forward. At the Atlas Works (Brown's) nickel steel experimental plates are in course of manufacture, which will be ready for trial in a month. One of them has been forced after cementation by a process which is doubtless very similar to the reforging carried out in the United States, though taken up some time since—before the American results were known here. Messrs. Vickers are also alive to the desirability of developing nickel steel armor, so that we may shortly hope to see good results. While hitherto neglecting nickel in vertical armor, we have happily succeeded in making thin nickel steel plates for decks and structure of ships with peculiar properties, and consider that in them we have a strong element embodied in construction.

" Passing on to shot, even the excellent Carpenter projectiles of large caliber, made in America, appear now to have been beaten by those known as the Wheeler-Stirling make. We know of no achievements in this country to compare with what these projectiles have done. With ever-increasing velocities we might have expected to have had to record bursts of guns during the year. This has not been the case either in England or on the continent. The smokeless powders lend themselves to the achievement of very high velocities combined with a low maximum pressure.

" It can hardly be said that the year has shown good results for the very small-bore rifles adopted by almost all military powers. Some trials on carcasses showed that singularly little harm was done in perforating flesh, but it was explained that in living bodies the inelastic moisture present was violently thrown outward and enormous holes made. This was illustrated in lecture experiments with moist clay and the like. This was too readily accepted; suspicion should have been aroused by the fact that wild animals grazing did not always find out when they were hit; and still more direct evidence was afforded us when a collier, shot through the thigh in a riot, walked about for an hour or two fancying that he felt something, but not troubling much about it. Now evidence has poured in from opposite quarters of the world to the effect that the small bore is singularly deficient in stopping power. It might be said, indeed, to have the opposite effect, for a retreating Chinese is thought to have had his pace rather accelerated as a rule when struck by a Japanese small-bore bullet. Medical reports from England, the continent and America show that the wounds made both through flesh and bone give generally remarkably little trouble and heal with great rapidity. Our troops recently sent to Ashanti have been armed with the old Martini carbine of 0.45-inch bore, nor can we wonder. Savages who have not had the advantage of hearing the lecturer prove the effect of the bullets to be so terrible, would, we fear, take little or no notice of bullet wounds made by the 0.303-inch bore, unless they struck in a really vital place, such as the brain or heart, and these organs are perhaps not specially large in savages. Seriously, something will have to be done about the small-bore bullet; perhaps the partial removal of nickel covering may cause setting up of the bullet to a reasonable size on impact. If this is contrary to the Geneva Convention, might it not be laid down that a civilized soldier must retire from action after a certain number of hits, say two or three? For it appears that even this number have not always caused serious inconvenience at the time."

MODERN PROJECTILES, BY V. G.

[LE YACHT.]

Every warship being on the whole intended to fire projectiles and, as a necessary consequence, to receive some, it may prove interesting, in view of the numerous and heated debates raised through the introduction of new types of vessels in the European navies (not excepting the United States), to examine which are the kind of projectiles more likely to be adopted and their probable effects. Considering, moreover, that a vessel

has to contend against guns of a superior design to those it was expected to face, a gun requiring relatively little expense for improvements compared with a ship, it may be equally interesting to say a few words in regard to the progress that the near future has in store in the way of projectiles.

At the present time the naval ordnance possesses two types—armor-piercing shells and shells with high explosive charges.

The armor-piercing shell, as its name indicates, is intended to penetrate the heavy armor plates of a vessel and eventually to injure her vitals. In theory there does not exist an armor plate capable of resisting the perforating energy of a high-power armor-piercing shell, but in practice its efficiency is doubted by the most competent judges of ordnance. If the projectile strikes the enemy's ship above the protective deck it goes right through the light upper works without doing much damage, for its powder charge is, in fact, feeble. The bursting of the shell is produced exclusively by the impact of the projectile, and there is very little probability of an explosion resulting from contact with sheet-iron or even light plates. Were it even to occur, the damage would be far less than that caused by a shell charged with a high explosive, however small.

For an armor-piercing shell to produce serious damage it must strike the thick part of the armor-belt and tear it asunder so as to cause a large opening for the rushing water, or else going clear through, burst in the interior of the vessel. Now the target presented by a belt hardly rising 0.60 m. to 0.70 m. above the water-line, and constantly screened by the crests of the waves, is extremely small. If we reflect, moreover, that an armor to be seriously damaged must be hit at a favorable angle, and that the firing of heavy caliber guns is relatively slow, we can easily understand that the effects of armor-piercing projectiles are rather uncertain. The common shell is now-a-days far more to be dreaded, for it is not now as formerly by its mass or its broken pieces that it acts, but by the destructive power of the gun-cotton, nitro-gelatine or melinite with which it is charged. These shells, in fact, are real torpedoes fired at a greater distance and with far more accuracy than the automobile torpedo. The charge of these flying torpedoes is much smaller than that of submarine torpedoes, although certain heavy caliber shells contain the same charges as the Whitehead, but on the other hand rapid-fire guns can pour into the enemy's vessel a perfect hail of missiles in a comparatively short space of time.

The ideal in this class of projectiles would naturally be to carry the heaviest possible weight of metal in order to produce an explosion in the interior of the vessel.

Fortunately, up to the present at least, it has been found impossible to fire this class of projectiles against a plate several centimeters thick without its exploding on impact on the outside. In the latter case the results are of little consequence; on the other hand the effects are terriffic when the projectile explodes in the interior after going through the hull when the latter is only formed of thin plates.

Experiments made in France on the Belligueuse and at the Gâvres Proving Grounds, as well as in England on the Resistance, have demonstrated the above facts beyond a doubt.

Everything in proximity to the explosion is completely wrecked, thousands of pieces of shell flying in all directions with incalculable force

and crashing through decks and partitions alike. When the explosion takes place above the protective deck the latter is torn open, and the flying debris, forming so many projectiles in turn, demolishes everything below. In addition to these mechanical effects, the nitrous vapors and the oxide of carbon generated render the air absolutely unfit for breathing during a considerable space of time.

The shells are not only dangerous when bursting in the interior of the vessel; when falling in close proximity to the ship they explode under water by contact with the hull, producing the same effects as the ordinary torpedo. Experiments made on the Provence have completely proven this fact. In case of war, shells with explosive charges will be almost exclusively used, first on account of their tremendous destructive power, and then because the unprotected superstructures of most of the warships now afloat form a target far more easily reached than their thick armor. Thus it is that the ordnance men of all the European navies are hard at work improving them. The problem is not very easy of solution. The qualities of the high explosive shell seem to antagonize, so to say, one another. The heavier the charge and the thinner the casing the greater the liability of the shell to burst at the slightest shock.

The Americans first conceived the idea of firing torpedoes against the enemy's vessel through the air. Not having at command an explosive sufficiently reliable to withstand the shock of a gun firing a powder charge, they tried pneumatic guns. In order to make the experiments more conclusive they did not hesitate to build a vessel of 2500 tons—the Vesuvius—which carried three pneumatic guns 30 meters long. The results were not commensurable with the sacrifices made. The range of the guns was too small. The necessity of training the latter by means of the vessel itself deprived the firing of anything like accuracy. Finally, the sheet-iron tubes protruding upward more than ten meters would, in action, have been disabled in a very short time. The trials of the Vesuvius put, for the time being, an end to pneumatic guns in the United States. Their ordnance men adopted the ideas of their European colleagues and sought to utilize the ordinary gun in firing projectiles containing the highest explosive charges and capable of piercing without bursting, the greatest metal thickness possible.

Owing to the secrecy with which the different governments jealously guard their researches it is impossible to form a comparison of the results obtained. It is pretty certain, however, that the problem has been satisfactorily solved in England and the United States. The general features of the battleships lately put upon the stocks, and the particular care taken to protect the superstructures, do not admit of any other interpretation.

Our (French) Naval Ordnance Department, after a brilliant beginning in the study of high-power projectiles, has allowed itself of late to be distanced. About eight years ago, and probably for the first time, experiments were made at Gâvres with thin steel shells charged with melinite. The projectile gave great satisfaction through its ability to traverse thin plates without exploding, but owing probably to some defects in the fuses there were many premature explosions.

The Navy Ordnance Department then abandoned the experiments and went back to the ordinary cast-iron shell, substituting only melinite for the common powder. The latter projectiles are not only wanting in

power, owing to the thickness of the metal, but on account of lack of hardness they are more sensitive to shock than steel shells of thinner make.

The most curious part about it is that the War Department took hold of the experiments abandoned by the Navy and brought them to a successful issue. The War Department possesses at present, if we are to rely on information gathered from various essays, high-power projectiles of all calibers up to 27 cm. The thickness of the shell is only one-tenth of the caliber. The projectile of 27 cm. contains a charge of about 60 kilos of melinite. It is perfectly safe in handling and firing. It is extremely desirable that the Navy resume without delay the study of high explosives. By simply adopting the method in use in the War Department for its projectiles of high explosive charges, the power of the naval armament would be considerably increased. The expense would be small, for it is only a question of manufacturing new projectiles without any alteration in the guns or their installations aboard.

The influence of the introduction of high-power explosives upon the construction of warships can all the easier be predicted now when it is a partly accomplished fact. To the decrease in importance as an offensive factor of the armor-piercing projectile corresponds, as a matter of course, the decrease in importance of the water-line belt as a defensive power. To the possibility of reaching the vitals of the vessel by means of high explosive shells going through and exploding in the upper works, must correspond the greatest possible protection to the superstructures, the adoption of the double-protective deck, and, according to our idea, the elimination of everything not susceptible of protection. The presence of superstructures is a source of danger, not because of their existence, their destruction having little importance from a military point of view, but because they are the means of causing the explosion of high-power projectiles. It is not unlikely that further researches will soon discover the means of penetrating the thickest possible armor. The protection of superstructures must therefore keep on increasing, and, eventually, unless the size of battleships is to be augmented beyond measure, their exposed surface must dwindle down more and more until, after a time, the vessels will nearly resemble the monitor type—the only one that is to some extent proof against the new projectiles. Again, if it be true that high-power projectiles, acting like torpedoes when exploding in the water, are not dangerous in a horizontal firing, it is quite different in the case of a plunging fire. In the first case the projectiles fired almost horizontally have a great chance of rebounding on the water and exploding in the air; in the second, however, falling normally they will burst in the water and damage the hull. Up to the present time, owing to the rolling and tossing of vessels, a plunging fire does not guarantee great accuracy. With a coast battery, however, where the train can be regulated in advance, the result would be to throw in the vicinity of the vessel a perfect shower of projectiles, all acting like so many torpedoes. Nothing can protect a vessel against a plunging fire. If new discoveries, difficult to conceive of at the present time, but still not improbable, should allow of more accuracy in a plunging fire, the defensive power of vessels would be extremely diminished. Their reduced size, joined to high speed and extreme mobility, alone would present some guarantee of protection.

J. L.

THE TRAINING OF FRENCH NAVAL OFFICERS.

[ENGINEERING.]

The recent establishment in France, by the Department of the Marine, of a technical training college for officers of the Navy is regarded as an important step that has been taken in consequence of sustained efforts made by those most earnestly seeking to raise the standard of efficiency of the French Navy.

In France, as elsewhere, special training is necessary for the creation of naval officers, and it has long been recognized with regret that adequate preparation does not exist there.

When, a short time since, the 1896 budget for the Navy was under discussion in the French Chambers, a careful examination was made of all the schools in which naval or marine officers were specially trained: it was considered that the instruction thus given was very imperfect, and that the existing primary and advanced naval schools involved a great outlay without commensurate return. A general desire was expressed in the Chambers, either that less money should be expended on these schools, or that they should be supplemented by a thoroughly efficient and superior naval college.

There exists in France a superior military college for the benefit of army officers; this is the Ecole Supérieure de Guerre, which is established at Paris. Its purpose, as defined by the regulations prepared when it was established, is the development of advanced military studies in order to create thoroughly efficient officers. A condition of admission to this school is that the applicant must have a captain's or lieutenant's rank in one branch of the service—infantry, cavalry, artillery, etc.—must have had five years of service as an officer, and have passed three years with the army or as a military instructor. The candidate must pass an examination, with the permission of the corps commandant, before he is admitted. The details of this examination are changed every year, and approved by the Minister of War. It varies, however, but little, and deals broadly with military tactics, topography, the preparation of plans, history, geography, and equitation; subjects are also given to show familiarity with modern languages, artillery, fortification, international law, etc.

It was with a strong sense of the importance of such facilities for the proper training of naval officers, that the Minister of Marine prepared a scheme, for which he has obtained the Presidential sanction, for the establishment of a superior naval college. The Minister advanced arguments which appeared to him fully to justify such a step. In order to secure the greatest efficiency in the fleet during a time of war, the personnel must have been able beforehand to make itself familiar with the constant changes and transformations that take place in war material. "France possesses no institution where the science of tactics can be properly taught to officers who will be called upon to assume responsible commands at sea; it is necessary that such officers should, from the moment of their going on board ship, be so educated that they could immediately carry out suitable tactics in the presence of an enemy." The Minister also enlarged on the satisfactory results that are now obtained at the Ecole de Guerre existing for the benefit of army officers, and he maintained that it was necessary "to create for the marine a corresponding organization. The establishment of such a school implies

a practical training in view of actual war, and as a sailor's most useful place should be on board ship, a floating school is necessary, consisting of cruisers placed under the control of a general commandant. It is only with the facilities that would be obtained by this arrangement that great naval tactical problems, and all the consequences they involve, could be worked out." It is with this object in view that the organization has been completed and the school established "to facilitate the investigation of problems inseparable from modern naval war, and to make as large a number as possible of officers familiar with the duties and responsibilities of command." In order to give as practical an aspect to this scheme as possible, and at the same time to carry it out with as little expenditure as might be consistent with efficiency, the school is installed on board ships already in commission; these vessels constitute an independent naval division under the command of a general directing officer. The existing plan of mobilising the fleet is not in any way modified by this formation, because it will be always possible during the general manœuvres to summon the several vessels constituting the training squadron, to take their place with the rest of the fleet. At present the training division is made up of three cruisers—the Admiral Charner, the Suchet (these two forming part of the Mediterranean squadron), and the Latouche-Tréville, which has been told off from the northern squadron. Vice-Admiral Fournier has been elected head of the school, and flies his pennant on the Admiral Charner. His staff consists of a captain, two lieutenant aides-de-camp—one of whom is selected from the students—one chief engineer, one assistant engineer from the State dockyard, one director of administration, a division surgeon, and one captain of marine artillery. On board each of the ships forming this division there are a captain, a commander, one chief engineer of the first class and three engineers of the second class, one administrating officer, and a surgeon.

The officer-pupils for this school will be selected each year by the Minister of Marine from the general list of lieutenants proposed for advancement; this list is prepared by the Commission de Classement. The officers are nominated in the order in which they stand on the list, exceptions being made of those who are engaged on foreign service. The officer-pupils enter the school without passing any examination; they will remain there during one year, attending courses on the following subjects, among others: naval tactics, organization of attack, theory of naval signalling, coast attack and defense, submarine navigation, theory and practical construction, the actual condition of the French and foreign fleets and their equipments, the general principles of ballistics, torpedoes, machinery, the perforation of armor-plates, the analyses of historic facts that might be useful in their bearings upon modern fleets, the principles of international maritime law, hygiene, etc. During the period of their instruction the students will be examined on these different subjects, and when they leave they undergo an examination before a commission, consisting not only of the director and the captains of the training ships, but also of a vice-admiral commanding a squadron. If the students pass this examination successfully they receive certificates from the commission, and it is from such certified officers, and in the order of their leaving the school, that they will be drafted into the general staff, either for marine or land service. These positions are always one of confidence. In addition to this, one-third of all available commands are to be reserved for these certificated officers, according to their respective grades. The

professors are selected from among the officers of the various marine corps. Vice-Admiral Fournier has chosen those who are best recognized for their scientific attainments; he himself has taken charge of the course of naval tactics, in concert with the captains of the three cruisers. The work of the college has only just commenced; later on the division will be attached to the squadrons that will take part in the great naval manœuvres, an opportunity which will be full of special instruction for the students. Until then, however, the ships will not leave the Mediterranean coast, and will cruise between Port Vandres and Villefranche.

This new development has been very favorably received in France. It is recognized as affording the best means of teaching officers not to be specialists only, but enabling them to acquire a general knowledge of their profession, which is absolutely necessary before they can assume the responsibility of command. Certain unfavorable criticisms have, however, been made; it has been urged that the college ought to have been established on shore and not on sea; that there are many interruptions inseparable from the necessities of daily routine; that at sea the number of professors must be more limited and facilities for reference more restricted, while at the same time the number of students who can be received is more limited; it is also advanced as another objection that externes cannot take advantage of the college, such as officers of any grade desirous of completing some branch of study. It is hardly necessary to add that these critics had hoped to see the college established in Paris. All these objections are, however, too shallow to have called forth serious discussion. It is not to be expected that the naval college thus established is as complete as can be desired; it is, indeed, almost certain that various modifications and improvements will be introduced which will be gradually dictated by experience. It appears, however, very certain that the French Marine Department has, by its establishment, provided a means by which the standard of efficiency of the officers in the French Navy will be raised, and the fighting value of the ships they will command be considerably increased.

CORDITE.

[THE ENGINEER.]

Cordite is an intimate mixture of nitro-glycerine, gun-cotton, and mineral jelly, or vaseline. The thorough blending of the two main ingredients is promoted by the addition of acetone, a substance in which both are soluble during the process of incorporation. The mineral jelly acts merely in the way of restraining the violence of explosion, and serves also to produce a little smoke, which acts usefully as a lubricant to the bore of the gun. The curious effect of the intimate mixture of nitro-glycerine and gun-cotton is to modify their characters and properties altogether. The former substance is an unstable liquid, which decomposes with explosive force on account of the mobility of its molecules; while dry gun-cotton behaves in the same manner because of its highly porous nature, which permits ignition to take place almost simultaneously throughout its mass. Cordite, on the other hand, is a horny substance, which burns only on the surface even under the severe heat and pressure obtaining in guns, as is demonstrated by the fact that par-

tially consumed cords, blown out of guns, retain their shape though reduced often to extreme tenuity. The consequence of this property is that the rate of explosion can be regulated by varying the proportions of surface to volume; thus cords of smallest diameter burn more quickly than the larger sizes, and by slicing up the material into very thin discs, and omitting the vaseline, explosion, having almost the rapidity of detonation, can be produced. It thus becomes easy to adapt cordite to any nature of gun. The service pistol, for example, takes cords of .01 in. diameter, cut to short lengths, forming, in fact, a fine powder; while the new 12-inch wire gun takes bundles of cords ½ inch in diameter and 14 inches long.

Like nitro-glycerine and gun-cotton, cordite is sensitive to heat and light. Exhaustive experiments have shown that it is not expedient to expose it constantly to a higher temperature than 100° F., although it suffers no change if occasionally heated as high as 130° F. Long exposure to temperature above 100° F. leads, however, to no danger, but may occasion a very slow decomposition of the material, an effect which will show itself in the ballistics obtained from the guns it is fired from; but no change of this nature has as yet been actually observed. The finer the subdivision of the explosive, the more susceptible it naturally is to heat.

Experiments carried on during a whole winter in Quebec have demonstrated that the ballistics are not affected by extreme cold; but experience, even in this country, shows that cordite transferred suddenly from a very cold room into a warm one will occasionally extrude a minute portion of its nitro-glycerine, which appears as a very light dew upon its surface. But this exudation is gradually reabsorbed as the material gets warm; and in any case it is not a source of danger, nor does it affect the shooting qualities of the material.

Prolonged trials in India have also demonstrated that cordite does not suffer from exposure to the extreme temperatures of a tropical climate, and as magazines can always be arranged not to have a temperature higher than 100° F., there seems to be no reason why large quantities should not be stored for a considerable number of years. The occasional exposure to much higher temperatures in the pouches of the soldiers and the limber-boxes of the guns does not produce any deleterious effect. Direct sunlight quickly turns cordite into a very dark-colored substance, and diffused light has the same effect only after very much longer exposure. Direct light causes slow decomposition; but sticks exposed for several years to diffused light, though very much darkened in color, show no measurable chemical change. Owing to the total absence of dust, cordite is a remarkably safe explosive to manipulate. It can be exploded by a severe blow, as, for instance, by striking with a hammer a cord laid on an anvil; in such case the portion immediately under the hammer explodes, but the explosion is not communicated to the cord on both sides of the hammer.

When fired in the open, or even when enclosed in the 100-pound service cases, it only burns with a fierce flame even when in considerable masses. Thus, a bonfire made round eight cases piled up against each other only fired the contents of the boxes in succession as the wood of the boxes burned away, and not only was there no explosion, but the lids of the boxes were merely forced open enough to let the products of combustion escape. Again, a temporary magazine in which two tons

of cordite were distributed on reticulated shelves was kept at 100° F. a fortnight and then fired. There was no explosion. The slate roof was lifted off by the rush of gas and deposited on the ground beside the building, no more injured than would be accounted for by its fall; the windows in the brick gables were not broken, and the door had to be unlocked to give access to the firemen.

There is, indeed, some difficulty in igniting cordite even when it forms the charge of a gun, and primings of gun-cotton or black powder have to be used in the case of cannon, while in small arms the percussion caps have to be charged with composition which will give a good flash. When, however, the priming is sufficient, misfires and hangfires are rare.

The volume of the chamber of a gun compared with the weight of the charge is a matter of great importance. On account of the relatively large volume of gases given out and their high temperature, compared with the products of combustion of black powder, the density of the charge must be much less. Solid cordite measures 17¾ cubic inches to the pound, and if fired in a chamber of that capacity would give a pressure of at least 120 tons to the square inch, which would, of course, be destructive to any gun. If a density of 54 cubic inches be assigned, as is the case in some of the larger quick-firing guns, a pressure of 40 tons to the inch might be realized, and is nearly the maximum which can be obtained with black powder; whereas, if, say, 100 cubic inches to the pound be the density, as is the case in many guns, the pressure can never rise above 20 tons to the inch; consequently it is found that in guns with high density charges the pressure and velocities are much affected by climatic changes and by the conditions of the bore and of the shot. But even under such unfavorable conditions of density, the regularity of shooting is quite equal to that obtained with black powder.

The diameter of the cords is proportioned to suit the bore of the gun, the capacity of the chamber, and the length of travel of the shot. Up to the present the sizes made range from .01 inch diameter for the service revolver to .5 inch diameter for the new 12-inch naval gun.

With respect to erosion, it may be said that it certainly is not greater than that arising from the use of black powder, and it is of much more favorable kind. Black and brown powders scoop out and plough rough, irregular channels in the bore, whereas cordite appears to wash away the surface in a uniform manner. This effect is probably due to the absence of solid or liquid particles in the products of combustion, and to the presence of a large proportion of carbonic oxide at a high temperature. The erosion extends for only a few calibers along the bore, and owing to these circumstances expanding gas checks on the driving bands of the shot enable the gun to shoot well longer than when powder is used. It should be borne in mind also that the ballistics obtained by the use of cordite are very much higher, as a rule, than with black powder; in the case of the 12-inch naval gun, for example, the energy imparted to the shot is 1.8 times greater than in the old service gun, consequently increased wear must be expected.

The manufacture of cordite is extremely simple. The nitro-glycerine and the dried gun-cotton are mixed together in accurately weighed proportions. The liquid is poured over the gun-cotton, and mixed with it by hand till the nitro-glycerine is completely absorbed, and the resulting mass looks like a quantity of dirty white moist sugar. This mass is then placed into kneading machines with a proper proportion of acetone,

and is incorporated for three and a half hours, when about 5 per cent of vaseline is added, and the kneading continued for another three and a half hours. The mass then becomes a stiff dough, not unlike raw Jamaica sugar in appearance and about the same color, and is ready for squirting into any size or form that may be needed, for unlike the old powders, the composition of cordite is the same in every variety of size produced.

The squirting machines consist simply of vertical cylinders of various sizes, into which the dough is placed. They are fitted at their lower ends with one or more removable dies, and provided with pistons actuated by screws or by hydraulic cylinders. In the former case the pressure of the screw is transmitted through a hydraulic cushion, which gives the means of noting the pressure and also of relieving it when excessive. For the small sizes used in rifle ammunition, the cords are wound automatically as they issue from the dies on to reels holding about one pound each, these are blended together in tens on to a single reel, and six of the latter are combined on one reel, from which the sixty strands are fed into the cartridges. The larger sizes are either wound by hand on to reels, whence they are cut off in lengths, or they are delivered by the press on to an endless band to which knives are fastened at the required distances. The cord lies over the knives, which, passing under a small roller, cut through the cord and leave it ready to be picked off by boys and arranged in shallow trays. The small-arm reels and the trays of cut cord are placed in stoves, in which they are dried by exposure to currents of air warmed up to 100° F., and in this process all the acetone is driven off. When dry, the cut cords, like the cordite on reels, is blended so as to make uniform samples.

The danger of the manufacture is confined to the production of the nitro-glycerine and the drying of the gun-cotton. As soon as the two explosives are mixed together they appear to be incapable of explosion, except when confined in a gun.

ELECTRIC TRAINING GEAR.

[ENGINEERING MECHANICS.]

A fifteen horse-power electric motor is used to operate the 9.45-inch gun on French battleships, but only two-thirds of this energy is required. A French engineering works is now completing 40 turrets for battleships. This change in turret management from hydraulic power to electricity has been brought about by Canet in a comparatively short time. Trials have demonstrated the reliability under all conditions. The man in charge of the turret is always enabled to hold it under complete control; not only is he able to arrest the movement of the platform suddenly at any desired moment, no matter what velocity is imparted to the turret, without creating any shock or reaction to the heavy moving mass, but he is able at will to make the fine adjustment in training with great facility and speed through distances less than one fortieth of a degree. Tests of this class were repeatedly carried out at the trials in the presence of a large number of French and foreign naval officers. By the special arrangements introduced into the Canet turret, and the care with which all the parts making up the system are counterbalanced, the power required to revolve the moving parts is reduced to a minimum. The

work of turning the turret of the 24-centimeter gun, with its heavy platform, armored protection, and the gun itself, is performed with a 15 horse-power electric motor, or rather that is the nominal power of the motor provided, but as a matter of fact only about two-thirds of this energy are required. A 3 horse-power electric motor is sufficient for effecting all the operations of training the 12-centimeter guns and their lighter turrets. The ammunition hoist of the 24-centimeter gun is driven by a separate electric motor of 8 horse-power; this motor is controlled by a special type of commutator which imparts the intermittent motions required for the charging the hoist and raising and delivering the ammunition on the gun platform; the action of the commutator is entirely automatic and is provided with a safety device.

SILENT SETTING-UP DRILL.

All the setting-up drill on the Raleigh—twice a day—is now carried on without orders. A petty officer or other leading man is placed where all can see him, and he and the rest of the division go through the exercises without a sound being uttered. It is found that the drill is done very smoothly and satisfactorily. By facing the men according to circumstances, no difficulty is found in seeing the leader.

It would perhaps be well to teach new men the names and orders for each exercise before they take part in this silent drill, which seems to have originated on the Dolphin.

SHIPS OF WAR.

[UNITED STATES.]

HELENA.

The gunboat Helena was successfully launched from the yards of the Newport News Shipbuilding Company on January 30, 1896. She is the third and last vessel of her class to be launched. She is built of steel throughout and depends wholly on steam as her motive power.

Her principal dimensions are: Length on load water-line, normal displacement, 250 feet 9 inches; maximum breadth, 40 feet 1 inch; mean draft at normal displacement, 9 feet; freeboard forward, 19 feet 9 inches; freeboard aft, 11 feet 2 inches; normal displacement, 1392 tons; coal carried at normal displacement, 100 tons; total coal capacity, 279.73 tons; speed, contract, and estimated, 13 knots; complement, officers and crew, 170 men.

She is designed to meet the requirements of roomy and well-ventilated quarters, so as to provide for refugees, as in the case of missionaries, and to enable her to carry a large landing party. She has berthing capacity for many men besides her crew, and carries ships' boats of an unusual size, her steam cutter and sailing launch being each 33 feet long, or as large as those supplied to the heaviest battleships. In external appearance she will resemble a small battleship, as she has a large military mast with two military tops, similar in all respects to the one on the

battleship Iowa, and which serves to command the banks of a river or houses in any town where she may have to prevent rioting. A conning-tower on the mast just below the first military top enables the ship to be manœuvred at a height of 45 feet above the water-line. Her after-body has been largely cut and two rudders, protected by heavy braces, to enable her to run with safety into a river and swing around in a narrow stream with the current. The armament consists of eight 4-inch B. L. R. F., four 6-pdr. R. F., two 1-pdr. R. F., and two Gatlings.

The Iowa.

The first-class battleship Iowa was successfully launched on March 28 from the shipyards of William Cramp & Sons. Her keel was laid in August, 1893. The ship followed after her coast-line prototypes, the Indiana, Massachusetts, and Oregon, and in design was purposed to excel the earlier ships, and how much she does so a comparison with the Indiana will show:

Indiana: Length on load water-line, 348 feet; breadth of beam, extreme, 69 feet 3 inches; displacement in tons, normal draft, 11,410; mean draft at normal displacement, 24 feet; freeboard forward, 11 feet 8 inches; normal coal supply, 400 tons; total coal capacity, bunkers filled, 1640 tons; maximum indicated horse-power, contract, 9000; speed in knots, contract, 15; complement of officers and crew, 460.

Iowa: Length on load water-line, 360 feet; breadth of beam, extreme, 72 feet 2.5 inches; displacement in tons, normal draft, 11,410; mean draft at normal displacement, 24 feet; freeboard forward, 19 feet; normal coal supply, 625 tons; total coal capacity, bunkers filled, 1780 tons; maximum indicated horse-power, contract, 11,000; speed in knots, contract, 16; complement of officers and crew, 490.

The hull is of steel, with a double bottom and close water-tight subdivisions extending up to a height of ten feet above the load water-line. The formation of the sides amidship, where they roll inboard, secured increased freeboard, without the added weight consequent were the lines carried up with the water-line fullness, gives an easier curve of stability, roomier quarters for the crew, greater sweep for the guns in the broadside sponsons, and promises efficiency of the great guns in almost any fighting condition of the sea.

For a distance of 185 feet amidships the water-line region is reinforced by a 7½-foot belt of 14-inch steel, three feet above and four and a half feet below the water-line. The forward and after ends of this belt turn inboard and athwartship with a thickness of 12 inches. Upon the walls so formed rests a flat protective deck of steel 2¾ inches thick, and from the lower edges of the athwartship bulkheads, running forward and aft to the bow and stem, are two other protective decks 3 inches thick, the forward one terminating just back of the ram.

From the top of the broadside belt and up to the line of the main deck, running forward and aft amidships for a distance of 90 feet, the sides are 5 inches thick, backed by a number of feet of coal and several inches of heavy yellow pine. Forward and abaft the casemate armor, from the protective deck up to the main deck, the outside plating is backed by a wide cofferdam filled with cellulose and divided into numerous compartments.

The Iowa will carry a main battery of four 12-inch breech-loading

rifles, mounted in pairs, in two barbette turrets of the balanced type 15 inches thick, firing through an arc of 270 degrees, and eight 8-inch rifles in four barbette turrets 8 inches thick, mounted on the upper deck, and possessing individual arc of fire of 170 degrees.

The secondary battery will be composed of six 4-inch rapid-fire rifles, four of which are mounted on the main deck in armored sponsons and sheltered by thick splinter bulkheads of steel, and the two remaining mounted aft on the bridge deck, sheltered by fixed shields. Twenty 6-pounder, four 1-pounder and four Gatling guns will constitute an auxiliary force and be mounted on the main deck, on the superstructure and bridges and up in the tops of the military post. From the bow or two places on either broadside there are torpedo tubes for the discharge of torpedoes.

The propelling machinery will consist of three double-ended boilers 21 feet long, with diameters of 16 feet 9 inches, and two single-ended boilers 10 feet long, with diameters of 16 feet 9 inches, in four water-tight compartments, and of two sets of triple-expansion engines, each in its own compartment and driving its own shaft, having cylinders of 39, 55 and 85 inches and a common stroke of 48 inches. The boiler supplying steam at a working pressure of 160 pounds, and the engines making 112 revolutions a minute, it is estimated that the ship will develop a speed of 16 knots an hour. With her bunkers filled, and at a cruising speed of 10 knots an hour, she should be able to steam about 7400 miles, while at full speed, under like conditions, she should be able to cover 3000 miles and have a radius of endurance of six days. Nearly a hundred auxiliary engines will add to the efficiency of the ship.

The conning-tower, of steel 10 inches thick, just beneath the pilot-house and behind and above the forward 12-inch turret, will be the fighting station for the captain, and through the armored tube leading below there will be means of communication to every important station essential to his knowledge and control in action.

The small rapid-fire guns are mounted in a manner assuring the greatest sweep. The use of wood has been reduced wherever possible, and the major part of that used will be subjected to an electrical fire-proofing process of tried efficiency.

The New Torpedo Boats.

[Scientific American.]

A second triple addition to the mosquito fleet of the United States Navy has been provided for in the act of Congress of March 2, 1895, appropriating for the construction of torpedo-boats Nos. 6, 7 and 8, the individual cost of which, including governmental superintendence, preparation of plans, and the provision and installation of ordnance outfit must not exceed $175,000—a moderate allowance, which, but for present prices and skillful management of design, would be impracticable.

With the completion of these and the three other boats authorized in 1894, the service will be possessed of eight craft of this order, representing four periods of constructive and engineering progression within the past six years. Of their kind, that of torpedo-boats pure and simple, the new vessels will be the largest in the world and unexcelled by those of any other nation, while in point of speed and weatherliness they will closely approach the more formidable torpedo-boat catcher—features demanded by our broken coast line.

With a displacement of 180 tons, they will be 170 feet between perpendiculars, with an extreme water-line beam of 17 feet upon a mean, normal draught of 5 feet 6 inches. The hulls are models of the most recent practice, with an easy razor-like entrance and a long fine run below water toward the screws. The "tumble-home," which begins just forward of the midship section, increases afterward, where it broadens out over the propellers, giving a very full water-line area of shallow draught. This flat form of stern prevents the settling so common to torpedo-boats under full power, while holding to the water in all conditions of weather and preventing racing of the screws.

The boats will be built of steel. The armament will consist of three 18-inch torpedo-tubes on swivel mounts and of four 1-pounder rapid-fire guns. Six hundred rounds of ammunition will be allowed for the guns, while four automobile torpedoes—the type yet undetermined—will be provided; the spare one being carried in a steel stowing case on the starboard beam. The torpedo discharges will be arranged on the main deck, two forward and one aft, the forward tubes being placed slightly *en échelon*, admitting of considerable athwartship fire in addition to the extended field of action of each on its own side. The after discharge will be on the center line, and will have an unhampered sweep of 280 degrees. This emplacement is devoid of "dead angles," and gives an all-round discharge of great scope.

The conning-towers, of which there are two, will be near the bow and the stern, each about 35 feet from its respective end. Hand-steering gear will supplement in the forward tower the steam mechanism common to both towers, affording one more chance in case of mechanical failure.

The forward tower will be surmounted by one of the 1-pounder guns, to be worked from a gallery on the after side. The three others will be mounted along the sides, two on the port and one on the starboard.

The freeboard forward is carried up to a height of 12 feet 6 inches, adding materially to the sea-going qualities of the boats while yielding increased berthing space for the crew and a housing for some of the forward mechanisms.

So important is speed in this type of craft that fifty per cent of the total displacement will be absorbed by the boilers, engines and appurtenances, and the magnitude of this amount may best be appreciated when it is known that this allowance is just double that for the motive mechanism of the commerce-destroyers Columbia and Minneapolis.

The engines, which are of the triple expansion sort, each in its own water-tight compartment and actuating a separate screw, are very fine examples of power and compactness, beautifully balanced, with a very nice distribution and division of weights. With a common stroke of 18 inches, impelled by steam at a pressure of 250 pounds to the square inch, supplied by three water tube boilers that flank the engine space—two forward and one aft—the two six-foot manganese bronze screws will be driven by the engines at the rate of 395 turns a minute, developing an indicated horse-power of 3200, and driving the boats through the water at a speed of 26 knots an hour.

The normal coal supply will be 12 tons, with a total bunker capacity of 60.

There will be no search-lights, but the boats will be lighted by electricity; and natural ventilation will be ample to insure comfort under all conditions of service. Folding boats will be carried.

The officers will be aft, while the crew will be provided for in the forecastle and just below on the berth deck. Excepting the captain and engineer, who will have separate state-rooms and bunks, the two other officers, the four machinists, and the sixteen seamen, each in a common country, will sleep in folding berths, easily turned out of the way to afford added space and comfort when not in use.

No premiums are offered for increased speed, and, with the well-known governmental margin of safety, the penalties for decreased speed need not be feared; while even a more excellent performance may reasonably be hoped for.

One boat will be built by Moran Brothers Company, of Seattle, Washington, for $163,350, and the two others will be built by the Herreshoff Manufacturing Company, of Bristol, R. I., for $144,000 apiece.

[ENGLAND.]

BRITISH WARSHIP BUILDING NOTES.

[ENGINEER, March 13.]

In view of the new orders for battleships, cruisers, etc., which may shortly be expected to be distributed among the Royal Dockyards and private shipbuilding and marine engineering establishments, the following notes of the progress made with some of the unfinished battleships and cruisers ordered under the late Spencer programme may be of interest at this time.

Of the battleships nearest completion the first to be noticed is the Renown, an armored steel vessel of 12,350 tons displacement, which was built at Pembroke and launched last May, and has been engined by Messrs. Maudslay, Sons & Field, of Lambeth. The progress made—after her launch—in fitting the machinery was so rapid that she was enabled to leave Pembroke for Devonport on November 14th under her own steam. The Renown is the only ship of her design yet constructed, and it is noteworthy that the new battleships to be built under what we may now, we presume, call the Goschen programme, are all to be of the Renown type, but with some increase in displacement and armament. It is also worth noting that the time taken—six months only—in fitting the engines and boilers on board the Renown in Pembroke, where very poor facilities for such work exist, was appreciably less than in the case of the Magnificent at Chatham, and the Majestic at Portsmouth.

The next battleship in order of completion is the Prince George, an armored steel vessel of 14,900 tons displacement, built at Portsmouth, and engined by Messrs. Humphrys, Tennant & Co., of Deptford. The whole of this vessel's machinery, boilers, etc., is in place, but the work upon the ship has been very fitful in its progress; it is, however, so far advanced that she will be ready for steaming at moorings in May, for her official trials in July, and it is hoped she will be completed in October.

Rapid progress is being made with the new battleship Victorious, lately launched at Chatham Dockyard, and described in our columns, large numbers of workmen of all trades being employed upon her, many of them working overtime. About seven-tenths of the whole weight of the structure, including armor, has been built into her, but the casemates are rather backward, due to their armor not being delivered fast enough from the contractors.

The builders of the engines, Messrs. Hawthorn, Leslie & Co., of Newcastle, are employing a large staff, working overtime, to get the machinery fixed in the ship as soon as possible. The main engines and boilers are now in place and in a forward state, and the fixing of the auxiliary machinery, which includes about eighty sets of engines, is being rapidly proceeded with. The armament is being fitted in place, and the hydraulic machinery for working the 12-inch breech-loading guns to be carried in the barbettes is also being steadily advanced. Every exertion is being made to have a trial of the machinery of the ship in the dockyard basin in June, and it is expected that the vessel will be able to proceed to sea for her official steam trials in July, and be finally completed next October.

The first-class cruiser Powerful, building by the Naval Construction and Armaments Company at Barrow, is rapidly approaching completion, the whole of the structure of the hull and steel work in her being finished, and the armor of the barbettes, casemates and conning-towers in place. All decks are laid, bridges and deck-houses up, masts and fighting tops stepped, and the rigging practically complete. The steering, windlass, capstan and hoisting engines and gear, with the anchor gear and air-compressing machinery, are all in place and complete. The magazines, shell and store-rooms are lined and fitted, and rapid progress is being made with the ventilating systems, electric light installations, telegraphs, etc.

The main engines and all the boilers, which are of the Belleville water-tube type, thirty in number, are now in place, leaving only the armor gratings and castings over the boiler-rooms to be closed and finished, and it is expected to have steam up in a couple of months.

The Terrible—sister ship to the Powerful—building by Messrs. J. and G. Thomson, of Clydebank, is making very fair progress towards completion, but in consequence of the late strike in the Clyde district, and the engineers having only lately resumed work, the construction of the ship has been much retarded. As, however, the contract date for her delivery is January, 1897, this will no doubt easily be anticipated by her builders.

The work of completing and getting ready for sea the new second-class protected cruiser Minerva, whose float out at Chatham Dockyard was recorded by us last September, is being pushed along at a truly marvellous rate. This vessel, it will be remembered, is being supplied with her propelling machinery by the engineering department of Chatham Dockyard, and it being desired that her steam trials may take place in May, and her final completion be effected in July, a very large number of all classes of workmen is employed upon her with this object. The material now worked into her weighs nearly 2400 tons, including armor; the fixing of her machinery is far advanced, the work of fitting her armament on board is well forward, and her torpedo-tubes are nearly complete. This vessel has a coal capacity of 550 tons, and her engines, which are of the three-cylinder inverted triple expansion type, driving twin screws, are expected to develop 9600 indicated horse-power under forced draught to her boilers, and to give her a speed with that power of 17¼ knots.

The progress of construction of the armored battleship Illustrious, now building at Chatham, is very much behind, when compared with the celerity shown in the building of her sister ship, the Magnificent, at the same yard. The first-named vessel was laid down just a year ago, but is as yet only plated up to the armor deck, some only of the frames of the

superstructure above that deck being in place. The boiler bearers and part of the auxiliary engine bearers are also in place, but the outer brackets for carrying the stern shafts will not be ready for a month.

The propelling machinery of this vessel has long since been completed by the engineer contractors, Messrs. John Penn & Sons, of Greenwich, and is waiting for transmission to the ship. It will be some considerable time before the vessel can take the water, unless a greater number of hands than is now employed is started to work upon her.

TORPEDO-BOAT DESTROYERS.

[ENGINEER.]

Two very successful trials of torpedo-boat destroyers, built and engined by Messrs. R. W. Hawthorn, Leslie & Co., Newcastle-on-Tyne, have recently taken place. The vessels are the Sunfish and the Opossum. The following particulars will be read with interest. The Yarrow boilers have given perfect satisfaction. They have no down-comers, and thus practically refute the contention of some writers that down-comers are essential:

Particulars of Three Hours' Full Power Trial of H. M. S. Sunfish.

Date of trial, 15th January, 1896

Draught of water, forward	5 ft. 1 in.
" " aft	8 ft. 1 in.
Displacement	281 tons.
Speed of vessel	28.03 knots mean of 6 mile runs.
Speed of vessel	27.581 " " 3 hours.
Steam pressure in boilers	188 lb. per sq. in.
Air pressure in stokeholds	2.95 in. of water.

		Starboard.	Port.
Vacuum in condensers		25.3	24.1
Revolutions per minute		353.8	349.8
Mean pressure in cylinders	H. P.	81.4	82.8
	I. P.	35.4	35.9
	L. P.	15.1	15.4
Mean I. H. P.	H. P.	702	707
	I. P.	702	704
	L. P.	676	683
		2,080	2,094
Grand total		4,174	

Eight boilers of the Yarrow straight-tube type, with 8506 square feet total heating surface and 160 square feet total grate surface.

Length of vessel, 200 ft.; beam of vessel, 19 ft.

Particulars of Three Hours' Full Power Trial of H. M. S. Opossum.

Date of trial, 3rd February, 1896.

Draught of water, forward	5 ft.
" " aft	8 ft. 1¼ in.
Displacement	279 tons.
Speed of vessel	28.242 knots, mean of 6 mile runs.
Speed of vessel	27.131 " " 3 hours.

		Starboard.	Port.
Mean pressure in cylinders	H. P.	81.9	80.3
	I. P.	33.9	34.1
	L. P.	13.6	14.9
Mean I. H. P.	H. P.	683	674
	I. P.	650	657
	L. P.	585	646
		1,918	1,977
Grand total		3,895	

Steam pressure in boilers	192 lb. per sq. in.
Air pressure in stokeholds	3 in. of water.
Vacuum in condensers	26.5 in.
Revolutions per minute, starboard	341.6
" " port	344.3

Boilers same as Sunfish; vessel same as Sunfish.

The Desperate.

[Engineering.]

The Desperate, the first of six of the new class of torpedo-boat destroyers ordered from Messrs. John I. Thornycroft & Co., was launched from their yard at Chiswick on the 15th of February. The new destroyer is in general design similar to the Daring, built by the same firm, but, having to attain the speed of 30 knots, she is larger, and is provided with greater engine power. Her length is 210 feet; beam, 19 feet 6 inches; and depth, 13 feet 6 inches. To keep down the weight of the hull a new special make of steel has been used in it, which has a greater tensile strength of some ten tons to the square inch than the mild steel generally used. The propelling machinery of the new vessel is of the Daring type and arrangement, but is designed to indicate 5400 indicated horse-power, or 1000 more than that of the Daring. The boilers are of the Thornycroft water-tube type, three in number, the two forward ones being placed back to back with one funnel in common, and the after one with a funnel to itself. An improvement has been made by utilizing the space between the funnels and their casings as upcast shafts for the purpose of ventilation. A modification has been made in the bow and stem of the Desperate consequent on the high speed she is intended to attain, the bow having more flare, and the stem being made to rake forward, instead of aft, above water, thereby rendering her a much drier vessel than would otherwise be the case. The armament is to be six quick-firing guns—four on the broadsides, one forward and one aft—and two torpedo tubes. The Desperate was launched with all her machinery, boilers, etc., on board, and is practically ready for steaming, so that she should soon make her trials.*

The Pelorus.

[Engineering.]

On Saturday, February 15th, the new twin-screw cruiser Pelorus was launched from Sheerness Dockyard. The Pelorus is the first of a new type of third-class protected fast cruisers, several of which are to be built for the Navy. She is 300 feet long, 36 feet 6 inches beam, and will have a loaded displacement of 2135 tons, at which her mean draught will be about 12 feet 6 inches. The hull of the vessel is constructed of steel, and her vital parts are protected by a turtle-back deck, throughout her length, of steel plating, 2 inches thick, the stern and rudder posts, shaft brackets, etc., being of cast steel. The rudder is of the balanced type, and is worked by steam steering gear. The vessel has a poop and forecastle, and between them the waist extends to about half her length, the officers' quarters being aft under the poop and the crew being berthed forward. The propelling machinery of the ship, which is to be supplied and fitted by Messrs. J. and G. Thomson, Limited, of Clydebank, will consist of two independent sets of inverted three-cylinder triple-expansion engines, to be supplied with steam by eight water-tube boilers of the Normand type, and designed to develop 7000 indicated horse-power under forced draught, and to drive the ship at a maximum speed of

*At the preliminary trials of the Desperate, one of the new destroyers built by Messrs. Thornycroft & Co., the record for speed at sea was broken, four runs on the measured mile giving an average of 31.035 knots or 35¾ statute miles per hour.

20 knots. Of the coal to be carried, which will be sufficient to give the vessel a radius of action, at 10 knots, of about 7000 miles, part is to be stowed above the protective deck and over the engine and boiler rooms, while the remainder will be in side bunkers below that deck. The armament of the Pelorus will consist entirely of quick-firing guns, of which there will be eight 4-inch, eight 3-pounder, and three Maxim guns, two of the 4-inch guns being mounted on either side of the conning-tower on the forecastle and two on the poop, the remaining guns being distributed on the upper deck and at the bow and stern. The vessel is also fitted with two torpedo-tubes. The ship has two wooden masts, one at the after end of the forecastle and the other at the fore end of the poop, each being in two lengths, with a lowering topmast and pole in one. The vessel is lighted throughout by electricity, the current being supplied by two dynamos. The keel-plate of the Pelorus was laid on May 21st last, and the ship is to be completed in the coming June.

The Doris.

[Engineering.]

H. M. S. Doris, the second-class cruiser launched at Barrow, is similar to the Juno, launched some time ago by the Naval Construction and Armaments Company, Limited. She is 350 feet long, 54 feet beam and at 20 feet 6 inches draught displaces 5600 tons. She is constructed entirely of steel, with the exception of the stem, and she is sheathed with teak and coppered. Protection is afforded by a strongly-built steel deck extending the whole length of the vessel, her engines and boilers, magazines, etc., being further protected by an inclined Harvey-armored breastwork. Bunker accommodation is provided for 1000 tons of coal, reserve coal being stowed in water-tight bunkers above the protective deck, and extending over the engine and boiler space. A Harvey-armored conning tower is placed forward and a director tower aft. The propelling machinery of the Doris, which has been made by her builders, is designed to develop 9600 indicated horse-power and to give a speed of 19.5 knots. The vessel is also fitted with the usual auxiliary machinery for working feed and bilge pumps, turning and steering gear, fans, dynamos, distilling plant, etc., and she is lighted throughout by electricity. Her armament will consist of five 6-inch, six 4.7-inch, nine 12-pounder, and seven 3-pounder quick-firing guns, together with four .45-inch Maxim machine guns. The military tops to her two masts, which are of steel, will also be armed with machine guns, and there will be two submerged torpedo-tubes forward and one above water aft. Accommodation for a complement of 450 officers and men is provided.

Hydraulic Training Gear.

[Journal of the Royal United Service Institution.]

An improvement in connection with the service of hydraulics in our battleships is in course of adoption that will speedily obviate a serious drawback that hitherto attended the use of the machinery in cold climates. In the first instance, it should be explained that the operation of training, loading, etc., besides the free manipulation of a barbette, with its brace of heavy guns, is effected by water pressure, which derives its

initiatory force from a steam pump of great power situated immediately beneath the barbette and as low under the protected deck as the structure of the ship will allow. The advantage of water as the medium for setting in motion the local machinery has long been recognized by engineers; it is not subject to the vagaries of steam; it maintains under normal conditions a constant and equable pressure on the valves, and controls the heaviest cannon with the greatest rapidity and precision. On the other hand, it quickly deteriorates when subjected to extremes of temperature, and unless a constant velocity be maintained, when the thermometer falls to freezing-point, the water must be drawn off into the reserve tanks below. Ice forming in the pipes, through neglect of this precaution, has from time to time resulted in much damage to the machinery, when a cumbersome system of hand-controlling gear would have to be relied on, while, in the event of a pipe bursting, the guns themselves might be rendered useless. The disastrous effects of low temperature will now be remedied by the simple expedient of an extension of the steam system as already adopted in the Russian fleet. Copper piping will be introduced to follow circuitous leads of the pressure pipes wherever necessary, and by the steam within setting up a circulation of hot air, the water will be maintained at a working level of temperature. The Empress of India, while in dock, will be fitted with this slight but important addition to her auxiliary machinery, and all barbette and turret ships as they pass through dockyard hands for repair will be similarly provided.

[France.]

French Warship Building Notes.

The new war vessels with which the French Government propose to proceed this year are the Henry IV., ironclad; Jeanne d'Arc, first-class cruiser; and the Dunois and La Hère, first-class despatch boats. The plans of the Henri IV. are not yet finally approved, but she will have a displacement of 7000 tons, while her length will be 283 feet 4 inches, her breadth 66 feet 8 inches, and her draught of water 23 feet 4 inches. She will be built entirely of steel, her engines will work up to 7000 horse-power, and she will be propelled by three screws. Her estimated maximum speed is 15 knots per hour. At 10 knots per hour she will be able to steam 6000 miles. The Henri IV. is to be laid down at Cherbourg in the course of the second half of this year, and she is to be ready for sea by April, 1900. Her estimated cost, including engines and equipment, is £627,163. The Henri IV. has been designed by M. Bertin, who has also prepared the plans for the Jeanne d'Arc. This new cruiser is to have a displacement of 11,000 tons, and she is to be 476 feet 8 inches in length by 64 feet 8 inches in beam. Her draught of water is to be 27 feet 8 inches, and her hull is to be wholly of steel. She is to be fitted with vertical engines working up to 28,000 horse-power. Steam will be supplied by multitubular boilers on the Normand system. The Jeanne d'Arc, which is to be fitted with three screws, is expected to attain a maximum speed of 23 knots per hour. The Jeanne d'Arc is to be laid down at Toulon this month, and she is to be ready for sea by October, 1899.

The new coast-defense battleship Amiral-Trehouart has been carrying on her trials at Brest; during a two hours' run under forced

draught, with the screws making 108 revolutions, a mean speed of 15.4 was maintained, while the engines developed 7590 I. H. P.

The new second-class cruiser Bugeaud has had some successful trials at Cherbourg; in a preliminary full speed run the engines developed 9000 I. H. P., giving a mean speed of 19 knots.

The new gunboat Surprise has completed her trials at Cherbourg. The Surprise is the first of a new type, as all gunboats for foreign stations have hitherto been of wood or composite construction, and little fighting value, but the Surprise is built of steel, wood sheathed, and coppered. She displaces 629 tons, and is 184 feet 10 inches long, with 24 feet 6 inches beam, and 12 feet 3 inches draught. Her horizontal triple-expansion engines, supplied by cylindrical direct-flame boilers, were to develop 900 horse-power, and, driving a single screw, to give a speed of 13 knots, but at the official trials 1000 horse-power was developed, with a maximum speed of 13.6 knots. The bunker capacity is 73 tons, giving a range of 2500 miles at 10 knots and 1000 miles at full speed. The gunboat carries two 3.9 inch, four 2.5-inch, and four 1.4-inch quick-firing guns. She has a complement of six officers and ninety-three men.

The new torpilleur-de-haute-mer Aquilon has also completed her trials so successfully that her builder, M. Normand, of Havre, has won a premium of 20,000 francs for the excess speed obtained; during her preliminary trial at full speed, with the engines making 345 revolutions, the mean speed attained was 25.8 knots; at the official full speed trial, however, the mean speed was 26.17, rather more than a knot over contract.

The two torpedo-avisos to be built have been designed by M. Trogneux, and will be improved D'Ibervilles, with better sea-keeping qualities; they are to be called the Dunois and the La Hère, and will be built at Cherbourg, their dimensions being: length, 253 feet 6 inches; beam, 27 feet 6 inches; and the engines are to develop 6500 I. H. P., giving a speed of 23 knots, the boilers being of the Normand water-tube type, while the armament will consist of six 3-pounder quick-firing guns. Each vessel will cost 3,084,593 francs. A torpedo-boat destroyer, somewhat resembling the Hornet type, with a speed of 25 to 26 knots; a 30-knot sea-going torpedo-boat, the Thénard, of the Forban class; and two first-class boats will be built in private yards.

The Amiral-Duperré is to carry out some experiments with shell charged with new high explosives called cresylite, a powerful explosive, which it is expected will supersede melinite for charging shells supplied for service to ships in the fleet.

[GERMANY.]

According to the official navy list for 1896, just published, the Imperial Navy consists of ninety ships and vessels (exclusive of ships under construction), and these are classed as follows: First-class battleships, four (Kurfürst Friedrich Wilhelm, Worth, Brandenburg, and Wissenburg); second class, three (König Wilhelm, Kaiser, and Deutschland); third class, seven (Preussen, Friedrich der Grosse, Baden, Baiern, Sachsen, Würtemberg, and Oldenburg); fourth class, eight (Siegfried, Beowulf,

Frithjof, Hildebrand, Heimdall, Hagen, Odin, and Ægir); and there are thirteen small armored gunboats. Cruisers, second class, three (Kaiserin Augusta, Irene, and Prinzess Wilhelm); third class, seven (Gefion, Arcona, Alexandrine, Olga, Marie, Sophie, Freya); fourth-class cruisers, eight; gunboats, five; despatch vessels, nine; training-ships, fourteen; and ships for special service, nine. In torpedo craft the Imperial Navy is strong; there are eleven so-called division boats, which may be counted as torpedo-destroyers; sixty-four sea-going torpedo-boats; sixty-one first-class, and sixteen vidette-boats, a total of 156. There are, moreover, eight first-class boats building.

The new fourth-class cruiser Geier has completed her trials in a very satisfactory manner. A vessel of 1640 tons, the engines were, according to the contract, to develop 2800 I. H. P. under forced draught, but during the six hours full-speed run the mean I. H. P. was 2884, while during the last three hours it was 2956, the mean speed for the run having been 16.5 knots, half a knot over the contract. The armament consists of eight 10.5-centimeter (4-inch) quick-firing guns and seven 3-pounder quick-firing guns, with two torpedo-tubes. The Geier is to relieve the first-class gunboat Iltis on the China station, the latter vessel, since her first commissioning in 1878, having been, with the exception of a few months in 1886-87, employed entirely on distant stations.

Some three months ago the Normannia, of the Hamburg-American line and one of the auxiliary merchant cruisers of the German Navy, was commissioned for a fortnight for a trial cruise, complete with armament and stores. The Admiralty stipulates that these auxiliary cruisers are to have double bottoms and cellular subdivision to a little above the water-line, while the engines and boilers are to be protected by coal, which is to be considered as a reserve and only to be used as a last resource. In the Normannia, a ship of 8520 tons, the ordinary coal supply is 1750 tons. For armament the ship carries eight 15-centimeter (6-inch) 25 caliber-long quick-firing guns on the broadside, four 12.5-centimeter (4.9-inch) guns, two firing ahead and two astern, six small quick-firing guns, and eight machine-guns. The ship, moreover, carries two small torpedo-boats of 22 tons displacement and eight torpedoes for each boat.

[RUSSIA.]

It is stated that the Russian naval authorities have decided to substitute in the battleships Sissoi Veliky and Navarin, as well as in the cruiser Rossia, a telephone invented by Lieutenant Kolbasyeff for the speaking tubes now used. According to the Novosti, these vessels are also to be fitted with the electric alarm bells invented by Captain Vassilyeff for showing the ship has been hulled by shot.

Messrs. James and George Thomson, Ltd., Clydebank, launched, on the 17th of February, the Kiev, a twin-screw steamer of 5400 tons, built to the order of the Russian Volunteer Fleet for their cargo and passenger service between the Black Sea and Vladivostock. The Kiev is a sister ship to the Vladimir, launched recently, and is 419 feet long, 49 feet 6 inches broad, and 32 feet deep. Under the poop is accommodation for a limited number of first-class passengers, while the whole of the main deck is devoted to quarters for third-class passengers or troops.

There is a complete installation of electrical ventilating fans, besides other modern appliances calculated to promote the comfort of passengers. The machinery consists of two independent sets of triple-expansion engines, each driving a bronze screw, and a fair rate of speed is expected.

[JAPAN.]

THE BATTLESHIP YASHIMA.

[ENGINEER.]

On February 28th the first-class battleship Yashima was launched from the Elswick shipyard of Messrs. Sir W. G. Armstrong & Co., of Newcastle-on-Tyne. She is being built to the order of the Japanese Imperial Government, and was commenced on December 6th, 1894, so that little over a year has been occupied in completing her for the launch, and it is expected that she will be completed for sea, with all armament on board, in about the same time. The dimensions and particulars of the vessel are as follows:

Length between perpendiculars	372 ft.
Breadth, extreme	73 ft. 6 in.
Draught, mean	26 ft. 3 in.
Displacement, in tons	12,300
Indicated horse-power, forced draught	14,000
Indicated horse-power, natural draught	10,000
Speed, forced draught, estimated	18¾ knots
Speed, natural draught, estimated	17¼ knots
Coals carried at designed draught	700 tons
Coals carried with bunkers full	1900 tons

She is provided with a steel armor belt 8 feet in width, carried from 3 feet above to 5 feet below the designed load water-line. This belt extends over a length of about 230 feet, and has a maximum thickness of 18 inches, tapered to 14 inches at the extreme ends. The thwartship armor bulkheads which terminate the belt are 14 inches thick.

Immediately above this belt there is a light belt of armor 4 inches thick, terminated by screen bulkheads extending from the sides of the vessel to the barbette armor. Behind this 4-inch armor coal bunkers are arranged, so as to afford additional protection against gun-fire. A protective deck 2½ inches thick is worked horizontally over the main belt and bulkhead armor, and under-water decks of the same thickness give protection to the ends of the ship outside the limits of the armor. At the fore-and-aft ends of the belt, rising directly from the protective deck, are the two barbettes, formed of steel armor, 14 inches thick on the upper portions, reduced to 9 inches below.

The main armament of the Yashima will consist of four 12-inch 49-ton guns mounted in pairs in the barbettes previously referred to, and having also the protection afforded by 6-inch armored gun-houses. The foremost pair train from direct ahead to 30 degrees abaft the beam, and the aftermost pair through a similar arc.

The auxiliary armament will consist of ten 6-inch 100-pounder quick-firing guns. Four of these guns will be mounted on the main deck in armored casemates 6 inches thick, and six on the upper deck in sponsons and protected by heavy shields. In addition there will be twenty-four 3-pounder guns, four mounted in the fighting tops, eight on the shelter decks, four on the bulwarks and on the main deck. There will be five

fixed torpedo-tubes, one above water forward, and four submerged, two forward and one aft. All the armament is being constructed at Elswick. The Yashima will be propelled by twin-screw triple-expansion machinery, constructed by Messrs. Humphrys, Tennant & Co., of Deptford. Steam will be generated in ten single-ended cylindrical boilers, with a working steam pressure of 155 lb. There will be a great number of auxiliary engines throughout the ship, amongst which will be included the steering engines, air compressing engines, evaporating engines, capstan engines, distilling engines, hydraulic engines, and steam pumping engines for working the big guns.

[MARINE RUNDSCHAU.]

A contract has been closed with the firm of Armstrong & Co. for the erection of steel works in Japan. The specifications, according to Japanese newspapers, are as follows:

1. The materials to be supplied from England.

2. Of the workmen employed in the works, twenty per cent shall be Englishmen, the remainder Japanese.

3. Whenever a new weapon is invented in England it will be reproduced in the Japanese works.

4. A subsidy is to be paid to the Armstrong Company for a period of years.

5. After expiration of this period, the works are to be sold to the Japanese Government.

[SPAIN.]

The Spanish Government has ordered two torpedo destroyers in England. They are to steam at the rate of 28 knots per hour.

The torpedo cruiser Filipinas has been completed at Vea Murgia. The dimensions are: Length, 243 feet; breadth, 26 feet; draught, 9½ feet; displacement, 750 tons; speed, 20 knots. Radius of action of 3000 sea-miles. Armament, two 12 cm. B. L. R. with hydraulic recoil mounts, one forward, one aft, four 4.2 cm. Nordenfeldts, two 11 cm. Gatlings, and four under-water torpedo-tubes for Schwartzkopf torpedoes.

[AUSTRIA.]

[ENGINEER.]

On January 31st the official trial was made with the sea-going torpedo boat Viper, built for the Imperial and Royal Austro-Hungarian Government by Messrs. Yarrow & Co., Poplar. This vessel is 147 feet 6 inches long by 14 feet 9 inches beam, and was guaranteed to attain a speed of 24 knots when fully equipped and loaded, with 26 tons to represent armament. The Viper left Messrs. Yarrow & Co.'s yard at ten o'clock in the morning, and commenced her three hours' trial about noon at Thames Haven. During the middle of the three hours' trial six runs were made on the measured mile, during which the mean speed attained was 26.633 knots, and the mean speed for the three hours' continuous run was 26.638 knots—i. e. 2.638 knots in excess of the contract speed. The vibration was practically nil at all speeds, the machinery being balanced on the system first introduced by this firm. After the run the usual

manœuvring trials were carried out, all of which proved satisfactory. The boilers are of the Yarrow type, with straight tubes and no outside down pipes. The above result was obtained with an air pressure in the stokehold averaging seven-eighths of an inch of water.

[HOLLAND.]

[ROYAL UNITED SERVICE INSTITUTION.]

In the budget statement the minister declares that, with the exception of the armored ships Reinier Claezen, Evertsen, Kortenaer, Piet Hein, the protected cruisers Koningin Wilhelmina and Sumatra, and some torpedo-boats, the whole fleet is antiquated; further, that as the hulls of many of the older ships have become very deteriorated, their boilers and engines being also worn out, and their fighting value very small, it is wiser to spend money in replacing them in preference to patching them up any more. A complete reconstruction of the fleet is necessary, and a commencement has been made with the larger ships. For general service and for the auxiliary squadron ten new ships, and for home defense six new ships are necessary.

Although nominally the Netherlands fleet is, comparatively speaking, considerable, yet, in reality, as the minister states in his report, the number of serviceable vessels is very small indeed. The three new coast-defense armor-clads Evertsen, Kortenaer, and Piet Hein, now approaching completion, will be useful little vessels, but they are solely intended for coast defense; they only displace 3400 tons, their engines of 4500 I. H. P. giving a speed of 16 knots; protection is afforded by a 6-inch complete water-line belt; the armament consists of three 21-centimeter (7.9-inch) guns, of which two are mounted in a 10-inch armored turret forward, and the third is aft on the poop, protected by a steel shield; two 6-inch quick-firing guns are in sponsons, one on each beam, and there are further distributed in the tops and other parts of the ships 14 small quick-firing guns and three torpedo discharges.

[SWEDEN.]

In 1896 there were appropriated 1,500,000 crowns for the building of new ships. Under construction are (1) the armor-clad Oden, commenced in 1895, to be completed in 1897; (2) the torpedo cruiser Oern, the cost of which, including torpedoes, armament, ammunition, is to be 878,000 crowns. The vessel is twin-screw, of following dimensions: Length, 222 feet; breadth, 27 feet; draft, 9 feet; displacement about 670 tons. The armament of two 12 cm. guns and four 57 mm. rapid-fire guns. One bow torpedo-tube. The two engines, protected by a protective deck, to develop 4000 H. P., giving a speed of 19 knots. The Oern is building in Göteborg and must be delivered in August, 1896; (3) one first-class torpedo-boat of 85 tons, with a speed of 23 knots, with two torpedo-tubes, one fixed in the bow and the other, a moveable one, aft, is building at the Schichau works, to be completed in August, 1896.

[BRAZIL.]

The Brazilian Government has recently placed an order for two ironclads with the La Seyne shipbuilding yards, France. The *Standard* says the Brazilian Government will also shortly place contracts for three

4000 tons, 19½ knots, protected cruisers, ten ordinary torpedo-boats, eight torpedo-boat destroyers, and five submarine torpedo-boats.

[ARGENTINA.]

The Argentine Government has ordered eight new war vessels, to be built in England, viz: (1) the cruiser San Martin, somewhat smaller than the Buenos Aires, (2) a torpedo-boat destroyer of 30 knots, and (3) six torpedo-boat destroyers of 27-knot speed.

Arrangements have also been made with the Schneider Company of Creusot to place a battery of rapid-fire guns upon the battleship Almirante Brown.

The contract for the purchase of the Italian ironclad Saint Bon has been signed in Argentina, and it is very possible that the purchase of this powerful vessel will be followed by the acquisition of the Verese or Emanuele Filiberto, both splendid war engines.

Argentina has, besides this, engaged the services of Senor Luiggi, one of the best naval engineers in Europe, to fortify the long and perfectly open stretch of coast on the Zarate war arsenal, which will serve as a basis or foundation for fortifying the Argentine coast and making it next to impregnable.

[CHILI.]

Messrs. Laird Brothers, of Birkenhead, launched the Capitan Orella and Capitan Muniz Gamero, two of the four 30-knot torpedo-boat destroyers which they are constructing for the Chilian Government, similar to the boats of the same class which they are building for the British Government. The Capitan Orella was only ordered in August last.

The Chilian cruiser Ministro Zenteno was launched February 1st at Elswick. She is 330 feet 5 inches long by 45 feet 9 inches broad, has a displacement of 3450 tons, and will have a speed of twenty knots. Her armament is to consist of eight 6-inch, ten 6-pounders, and four 1-pounder quick-firing guns, with three torpedo-tubes.

[LIBERIA.]

GUNBOAT ROCKTOWN.

[THE STEAMSHIP.]

The vessel is 100 feet long between perpendiculars, or 119 feet extreme, 20 feet wide and 10 feet deep, the load draught being 7 feet. The hull is divided into seven water-tight compartments, and is entirely built of Siemens-Martin steel, with Lloyd's scantlings for the highest class. The engines are compound surface-condensing, the air, circulating and bilge pumps being driven off the main engines in the usual way. The cylinders are 15½ inches and 28 inches in diameter by 16-inch stroke. The boiler is of the ordinary return-tube type, of steel with steel tubes, and constructed to Board of Trade requirements for a working pressure of 100 pounds to the square inch. The boat carries a 57 mm. quick-firing Nordenfeldt gun on shielded mounting on the forecastle deck, and three 80 mm. breech-loading guns at the sides and on the poop deck. The trials of the gunboat were carried out on the river Maas, from Rotterdam to the Hook of Holland, both for speed and for the armament, and the conditions were successfully fulfilled, the mean speed of six runs being over twelve miles, and the machinery working smoothly throughout.

BOOK NOTICES.

The Naval Pocketbook, 1896, by W. Laird Clowes, published by the Tower Publishing Company, Limited, London, is the first issue of a proposed handy annual of facts and figures relating to the navies of all nations. It shows evidence of much care in compilation, and is well indexed. As special features, it contains profile and deck plans of nearly all the latest warships, showing their armor and the distribution of their batteries; and "trial trip tables," wherein is given, for a knot made in an observed interval of time, the corresponding speed of the vessel in knots per hour, the tabulated time intervals being tenths of seconds. A list of the dry-docks of the world, with their principal dimensions, is also one of the valuable features of the book. Its pocket size and moderate price, five shillings, should transfer much valuable information from reference books in a ship's library to the pocket of every officer.

J. M. E.

The 9th Annual of Aide-Mémoire de l'Officier de Marine, 1896, by Edouard Durassier, continued by Charles Valentino, published by Henri Charles-Lavauzelle, Paris, contains very complete statistics of the *matériel* and personnel of the navies of the world. These statistics, although not entirely free from minor errors, which can and should be eliminated, are, in the main, correct and well arranged. Republished in this edition from the *Revue Maritime et Coloniale* are some "deductions drawn from the battle of the Yalu and from the maritime operations of the Japanese," which are worthy of careful study by every naval officer. Thirty-six pages are devoted to a handy *résumé* of maritime international law. The tabulation of the cable communications of the world is a particularly valuable feature and could be doubled in value by the tabulation of cable rates. The book is of handy size, well printed, and moderate in price.

J. M. E.

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[American.]

JOURNAL OF THE MILITARY SERVICE INSTITUTION.

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March. A Decennium of Military Progress. The Balloon in the Civil War. Limitations of the National Guard. Military Duties in Aid of Civil Power. The Defense of our Frontier. Instruction of Sea-coast Artillery. Alaskan Notes. Reprints and Translations.

JOURNAL OF THE ASSOCIATION OF ENGINEERING SOCIETIES.

January, 1896. Quadruple Expansion Engines for Lake Service.

JOURNAL OF THE FRANKLIN INSTITUTE.

January, 1896. A New System of Machine Telegraphy. Metallurgical and other Features of Japanese Swords.

February. Commerce and Deep Waterways.

March. The Marsden Corn-pith Cellulose (by Lewis Nixon).

Mr. Lewis Nixon says: "We may sum up, that what appears to be the present policy of our Navy Department is not to give vessels abnormally great metacentric heights, as they want them to be at their best when they begin fighting, and not wait until they are dangerously punished before they become good gun platforms. The best way seems to be to fix a reasonable metacentric height and then take means to keep it. The Department's use of armor, armor decks and cellulose seems to meet this problem well. With the perfect obturation which can be obtained with the corn cellulose, naval designers can settle upon the metacentric heights and other features of their designs with confidence that they can be retained in an engagement. Our cruisers of the Baltimore type, if they are provided with a cellulose belt, would be warranted in engaging many of the second-class ironclads of other powers; without it they are liable to be sunk by a well-directed machine gun fire. This product of American farms affords a cheap and ready means of vastly increasing the efficiency of our cruisers, and the unarmored sides of all our vessels should have these belts without delay. This discovery and application of cellulose is

of as vital importance to our Navy as the development of Harveyized armor and smokeless powder. This follows from the fact that without adding very much to the cost of our vessels we can greatly increase the efficiency of them all by making their sides automatically resist the inflow of water, and as our cruisers carry heavier batteries than similar vessels of other nations, they would, when so protected, be able to give battle to ships far heavier than themselves."

THE UNITED SERVICE.

JANUARY, 1896. Prince Eugene at Belgrade. Korea in July, 1895. The English Soldier: as he was and as he is. Reminiscences of Seattle, Washington Territory, and the U. S. Sloop-of-War Decatur, during the Indian War of 1855-56. Notes on England's Navy.

FEBRUARY. The Old South still. General Jackson at New Orleans. Five Weeks with the Cuban Insurgents. Famous Words of Great Commanders. Reminiscent of the "New Ironsides" off Charleston. Naval Progress in 1895.

MARCH. Did Grouchy by Disobedience of Orders cause the Defeat of Napoleon at Waterloo? Ironclads in Action. Naval Progress. Naval and Military Notes.

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FEBRUARY, 1896. The Yarrow Experiments to determine Circulation in Water-tube Boilers. Some Comments on the Yarrow Experiments. The Circulation of Water in Boilers. Building a Modern High-speed Engine.

ENGINEERING MECHANICS.

FEBRUARY, 1896.—

A new method of face-hardening armor is being tried at the Pannier works. One face of the ingot intended for the armor plate is carbonized directly at the time of being run into the mold. This is effected by lining one wall of the mold with the necessary carbonizing material, which must, it is stated, be free from occluded gases, and of great durability, so as to remain stable during the process of casting. Experience has shown that the amount of cementation obtained varies with the carbonizing material used, about twice as much effect being obtained with charcoal as with coke. On withdrawal from the mold the cemented surface is slightly wrinkled, but this disappears in the after-working of the ingot. The heaviest ingot yet dealt with in this way weighed 3 tons, and was reduced from its initial thickness of 16 in. to 4 in. by forging and rolling. An examination then showed that for ¼ in. from the face the metal contained 1.78 to 1.50 per cent. of carbon, which decreased regularly to between .25 and .15 per cent. at the back of the plate.

ELECTRICAL ENGINEERING.

MARCH, 1896. Electrical Search-lights in Sea-coast Defense.

ENGINEERING NEWS AND AMERICAN RAILWAY JOURNAL.

JANUARY 16, 1896. A New Design of Multipolar Dynamo. The Medical Aspect of the Nicaragua Canal.

Report of Passed Asst. Surgeon E. R. Stitt, U. S. N.

JANUARY 23. A New Steamship Coaling System.

JOURNAL OF THE AMERICAN SOCIETY OF NAVAL ENGINEERS.

Vol. VII., No. 4. Contract Trial of the United States Coast-line Battle-ship Indiana. The Steam Yacht Yosemite. Test of a Babcock and Wilcox Boiler to determine its Evaporative Efficiency. Torpedo-boat Destroyers. Experiments to determine the Causes of Steam Pipe Explosions on board German Naval Vessels. Liquid Fuel for Naval Purposes. Trials of the Lake Steamships Zenith City and Victory.

Vol. VIII., No. 1. Contract and Screw Trials of the U. S. S. Katahdin: relation of the Duties of the Naval Engineer Officer to the Problem. Contract Trial of the Machinery of the Texas. The Reliability of Throttling Calorimeters. Measurement of Temperatures of Steam. Description of Experiments made at Yarrow & Co.'s Works. On Comparison of Mechanical Drafts. Belleville Boilers. The Accident on the St. Paul. Ashlin's High Pressure Compound System. A New Goubet Submarine Boat.

THE IRON AGE.

JANUARY 2, 1896. The New Army Magazine Rifle. Data about Torpedoes.

JANUARY 9. The New Colt Automatic Gun. The Necessity of Thorough Coast Defense.

JANUARY 16. High Explosives in Warfare.

JANUARY 30. Experiments showing Circulation in Water-Tube Boilers. A New Torpedo-destroyer. Specifications for Marine Boiler Steel.

FEBRUARY 20. Firing Tests of Krupp Armor Plate.

SCIENTIFIC AMERICAN.

JANUARY 4, 1896. The Argentine Cruiser Buenos Aires. Our Defenseless Condition. The Bridge of an Ocean Liner. The United States Battle-ship Iowa. New Submarine Boat.

JANUARY 11. Wire Wound Guns adopted in the British Service.

JANUARY 18. The Light Draught Composite Gunboats. The Advantages of the Induced over the Forced Draught System. Improved Arms for the National Guard. The New Torpedo-boats.

FEBRUARY 1. The Timber Dry Dock No. 3 at the New York Navy-yard.

FEBRUARY 8. The Power of Guns. Cape Hatteras Lighthouse. Stranding of Steamship St. Paul.

FEBRUARY 15. Launching of the U. S. Gunboat Helena. Firing the Indiana's Big Guns.

FEBRUARY 22. Soapsuds on the Waves.

Some experiments have recently been made, says Railroad Gazette, which show that soapsuds will reduce a sea almost as well as oil. This was first tried on the Scandia, an English steamer, in a storm on the Atlantic. Having no great quantity of oil, the master dissolved a large quantity of soap in water, which was discharged over the bow. The effect was nearly instantaneous, the height of waves being so diminished that the vessel could be managed without difficulty. Captain Le Gall, of the French steamer Sénégal, sailing the Adriatic, was struck by a squall and used soap and water with same result. He used three kilogrammes of soap dissolved in 70 liters of water. The solution when dripped over the bow made a quiet space about 10 meters wide, preventing the waves from breaking over the vessel.

MARCH 14. Defense of New York Harbor. Inaccessible Maritime Lights.

Description of electric buoys of New York harbor.

MARCH 21. The United States Cruiser Olympia.

A good description of Olympia and comparison with the Eclipse and Blanco Encalada.

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FEBRUARY. Modern Ship-building Tools. Long Distance Electric Power Transmission in the United States. Biographical Sketch of John I. Thornycroft.

MARCH. Some Recent Departures in Steam Engine Piston Construction. Modern Ship-building Tools.

[FOREIGN.]

THE ENGINEER.

JANUARY 3, 1896. The Engineer in Naval Warfare. War Material.

JANUARY 10. Circulation in Water-tube Boilers. American and Russian Armor Trials. The Royal Ordnance Factories. Corn-pith Cellulose for War Ships. The Buffington Crozier Disappearing Gun Carriage.

JANUARY 17. Naval Architecture: a Few Principles Popularly Explained: I. Displacement. Double Forged Carnegie Armor. Canet Electric Turrets.

JANUARY 24. The World's Principal War Fleets. Construction of Modern Lighthouses. The Blake Electric Rifle.

JANUARY 31. Steam Launch for Ambulance Service. Krupp's Armor in 1894-95. The Royal Ordnance Factories.

FEBRUARY 7. Naval Architecture: a Few Principles Popularly Explained: II. Stability. Torpedo-boat Destroyers. The Navy and the Admiralty.

FEBRUARY 14. The New Electric Drill for Naval Construction. Coast-defense Ships. The Harbors of India. A Feature of the New Naval Programme. The Reed Water-tube Boiler.

FEBRUARY 21. The Two New Docks at Portsmouth. Launches of H. M. S. Pelorus and Desperate.

FEBRUARY 28. Naval Architecture (cont.): III. Stability. Engine Rooms of Destroyers. Modern War Ships and Dock Entrances. Carnegie's Double Forged Plates.

Experiments are being carried out by the German Admiralty with petroleum fuel on board the Carola, the Siegfried, and several torpedo boats. The ironclads Odin and Œgir and Ersatz Preussen, now in course of construction, are to be fitted for this description of fuel. In our own Navy, the Gladiator will be the first ship fitted with apparatus for burning liquid fuel. It will be carried in tanks, but, oddly enough, the Gladiator will have larger coal capacity than the Eclipse class, which seems to show that the Admiralty does not yet take oil fuel quite seriously.

MARCH 6. Quick-fire Gun Sights. Engineers in the United States Navy. Anchor Gear of H. M. S. Victoria. Belleville Boilers in the Royal Navy. The Naval Program of 1896. Launch of the Japanese Battle-ship Yashima. H. M. S. Doris.

MARCH 13. Cordite. British War Ship Building Notes. Collisions at Sea. Present Strength of the New U. S. Navy.

MARCH 20. Naval Architecture (cont.): No. IV. Stability. The Element of Force in War Ships.

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DECEMBER, 1895. Balaklava. A Few Hints on Marching at Home and Abroad.

JANUARY, 1896. Notes on the German Siege Artillery and 4-Gun Field Batteries. Hints for the Guidance of Officers, at Foreign Stations, in the Detection of Precious Stones.

FEBRUARY. Capillary Ripples. Verifying at the Mean of the 100 Yard Bracket.

MARCH. Incidents of Bush Warfare. Adjustable Pointers for Concentrating the Fire of Guns in Groups.

ANNALEN DER HYDROGRAPHIE UND MARTIMEN METEOROLOGIE.

Vol. XII., 1895. The Typhoon of September 8 to 11, 1894, in the China Sea.

Experiences on the St. S. Tai-cheong in crossing the path of an advancing typhoon from the northeast to the southwest semicircle.

Uses of Photography in Navigation.

Four illustrations of views taken on board a steamer going 11 knots, with an ordinary camera, of headlands and the port of Las Palmas, distant from 1 to 2 sea-miles.

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JANUARY 11. The New Torpedo-boat Destroyers. Value of Naval History in the Present Day.

FEBRUARY 15. Meteorology and Naval Warfare. Health of the Navy.

FEBRUARY 22. Launch of Pelorus and Desperate. The Health of the Navy. Expeditions Over Seas.

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THE STEAMSHIP.

JANUARY, 1896. Ship-building Returns for 1895. Engineers for the U. S. Navy. Launch of H. M. S. Diana. The Liberian Gunboat Rocktown. The Fleet of the P. and O. Company. The Price of the New British Cruisers.

FEBRUARY. Electric Lighting in the Dutch Navy. Marine Boiler Explosions. Experimental Theory of the Steam Engine. The Blake and Knowles Independent Air Pumps. Experiments with Water-tube Boilers. Naval Notes.

MARCH. Repairing a Broken Trust Shaft at Sea. M'Kinnell and Buchanan's Patent Indicator. Worthington Pumps and Feed Heaters. Screening of Ships' Side-lights. The Latest U. S. Torpedo-boats.

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DECEMBER, 1895. Suggested Lines of Convoy in War Time, with a Scheme of Commerce Protection. Von Lobell's Annual Reports on the Changes and Progress in Military Matters during 1894. Naval and Military Notes.

JANUARY, 1896. The Chitral Campaign. The Tactical Training of Officers of Volunteers. The Seamen of the Guard.

FEBRUARY. The Production of Modern War Material in the United States of America. Naval Aspects of the China-Japan War. The Eyesight of the Soldier. Visual Signaling. The Seamen of the Guard.

MARCH. Our Sea-borne Commerce and Mercantile Marine. The Tactics of the Future. The Native Levy in the Ashanti Expedition.

ENGINEERING.

JANUARY 3, 1896. The 8-inch Guns of the Buenos Aires. Propelling Engines of the Spanish Cruiser Emperador Carlos V. Water-tube boilers. Torpedo-boat Destroyer Desperate.

JANUARY 10. The Stranding of French Battle-ships. Circulation in Water-tube Boilers. The Gunnery Trials of the Buenos Aires.

The principal armament consists of two 8-in. quick-firing guns, four 6-in. quick-firing guns, and six 4.7-in. quick-firing guns. There are also ten 3-pounder Hotchkiss guns, and six 1-pounder or 37-mm. Maxim-Nordenfelt automatic guns.

All the large guns are of 45 calibers in length, the Buenos Aires being the first cruiser carrying all her large quick-firing guns of this nature. The consensus of opinion appears to be so favorable to the arrangement, and indeed the ship carries her long guns so well, that it seems probable this ratio of length to bore, or perhaps indeed a higher one, may soon become the rule.

There are two 6-in. guns forward, one on each broadside, capable of firing from right ahead to 60 deg. abaft the beam; and two aft, one on each broadside, capable of firing from right astern to 60 deg. before the beam. These guns stow in the fore-and-aft line, their muzzles being close up against, but outside, the bulwarks supporting the bridges, and entirely within the ship's side.

The three 4.7-in. guns on each broadside have firing angles of 60 deg. before and abaft the beam; they also stow on the fore-and-aft line, but are trained inboard into the stowing position, their muzzles being elevated as necessary to clear the berthing as they are brought into position. It will thus be seen that all the guns are stowed with their muzzles within the ship's side, and yet there are no sponsons. The arrangement appears admirable, and seems at once to remove the usual objections to long guns.

These guns in the Buenos Aires have 2570 foot-seconds muzzle velocity, the projectile being 45 lb. for the 4.7-in. and 100 lb. for the 6-in., and the maximum chamber pressures being 15 tons per square inch.

The gun mountings are of the latest Elswick pedestal type. The shields for all these guns have a thickness of 4½ in. in front, tapering to the rear. The training is easy, so much so, that even with the 6-in. guns it can be done by the shoulder, without the assistance of gearing, which is, however, supplied in case of its being preferred.

JANUARY 17. The Machinery of H. M. S. Renown. The Gordon Disappearing Carriage for 10-in. Gun.

JANUARY 24. Gun Sights. Our Naval Position.

JANUARY 31. Barbette Carriage for U. S. 8-in. B. L. Gun. The Development of the Japanese Merchant Marine.

FEBRUARY 7. The Training of French Naval Officers.

FEBRUARY 21. Engines of Torpedo-boat Destroyers: Handy, Hart, and Hunter. Water-tube Boilers for the Dutch Navy.

MARCH 6. The Japanese Battle-ship Yoshima. The Royal Italian Armor-clad Sicilia. The Navy Estimates.

MARCH 13. The Italian Armor-clad Sicilia.

MARCH 27. Water-tight Doors and their Danger to Modern Fighting Ships. H. M. S. Desperate.

MITTHEILUNGEN AUS DEM GEBIETE DES SEEWESENS.

Vol. XXIV., No. 1. Theory of Naval Tactics. The Solomon Islands. Types of German War Ships. The English Torpedo-boat Destroyers. Accident to the Division of French Battle-ships. Foreign Navies. Boiler Explosion on the Turkish Torpedo-boat Destroyer.

No. 2. Theory of Naval Tactics (concluded). Types of American Cruisers. Peterson and Macdonald's Water-tube Boilers. Measurement of Wave Lengths in the Atlantic Ocean. On Steam Steering Engines. The Goubet No. 2. Foreign Navies.

No. 3. The French Fleet Manœuvres, 1895. The English Fleet Manœuvres, 1895. Report on the Extension of the Suez Canal. The Chinese Torpedo-boats No. 558 and 559. Foreign Navies.

No. 4. The Effectiveness of Naval Warfare and the Changes in its Character with the Times. Submarine Harbor Defense: Methods and Problems. The Submarine Boat Goubet No. 2. Foreign Navies. H. G. D.

MILITÄR WOCHENBLATT.

No. 1, 1896. Minor Notices: Building Gunboats for the Great Lakes. Battery of Dynamite Guns.

No. 9. The Krag Jorgensen Rifle in the United States.

Nos. 11 & 13. New Rules for Small Arm Target Practice. Shall the Field Battery of the Future consist of Six or of Four Pieces?

No. 14. Firing Rules for Field Artillery.

No. 21. Russia.

On January 9 a higher course of study of naval sciences was opened at the Nikolas Naval Academy. The course will comprise the following subjects: Naval Strategy, Naval Tactics, Naval and Military Statistics and Geography, Naval History, Marine International Law. In addition, practical exercises in naval tactics and strategy will be engaged in. The course thus comprises such subjects as are required by commanders of ships and of squadrons. The course is open to staff officers and flag lieutenants who have held their positions at least six years and who have completed the courses at the naval artillery or torpedo schools. This year the course is to last only four months. Next year it will commence on October 1 and end May 1 of the following year. There are no examinations, but at the end of the course the knowledge acquired will be shown by written essays. Nineteen officers take this year's course.

Nos. 25 & 27. Distribution of Vessels of the Italian Navy. Naval Construction in Sweden.

MARINE RUNDSCHAU.

JANUARY, 1896. The Oldest German Book on Naval Construction. The Cost of England's Ships of War (conclusion). Ascension of a Cameroon Peak. Foreign Naval Notes.

FEBRUARY. Blockade in Relation to Naval Strategy. The Value of Stars in Navigation. The Construction of the Harbor of Emperor Alexander III. Foreign Naval Notes.

MARCH. Collections for the German Fleet. Water Tubular Boilers. Armor Tests of 80 and 100-mm. Nickel Steel Krupp Plates. Foreign Naval Notes. H. G. D.

LE YACHT.

No. 924, NOVEMBER 23. Assignments of Torpedo-boats in Times of Peace.

No. 925, NOVEMBER 30. The Grounding of the three Battleships at La Badine.

No. 927, DECEMBER 14. The Reforms carried out by the Minister of Marine.

No. 928, DECEMBER 21. The Navy Estimates for 1896. The New Constructions.

No. 929, DECEMBER 28. The Indispensable Fleet, by Rear-Admiral Fournier.

This remarkable book, the full title of which is "The Necessary Fleet, its Strategic, Tactical and Economical Advantages," is divided into two parts, the 1st treating of the fleet as regard the material, the 2nd relating to the advancement of the personnel. In the first volume the Admiral establishes the principle of a homogeneous fleet of a superior type of sea-going and fighting ships, and advocates for the composition of the naval forces a series of squadrons formed of a certain number of identical vessels, accompanied by torpedo-boats. These vessels should be of the Dupuy-de-Lôme class enlarged, displacing about 8300 tons. Their entire upper works would be protected by extra-hardened steel plates 150 mm. thick, their speed and radius of action to be as considerable as possible. Their armaments would consist of below-water-line torpedo-tubes and R. F. 16-cm. or 19-cm. guns. In the second volume the author deals mathematically with the intricate question of stagnation in the Navy, and presents nearly the identical features of the state of affairs in our own Navy.

No. 930, JANUARY 4. The Navies of the World in 1895.

No. 931, JANUARY 11. The Superior School of War.

By a decree dated last December, a superior school for naval officers was established. Three months later it was in operation. The school comprises three vessels forming an independent flying division under command of Rear-Admiral Fournier, Superintendent. The new school in its present organization is variously commented upon in the Navy.

Nos. 934 & 935, FEBRUARY 1 & 8. The Merchant Marine and the Association Technique Maritime.

No. 937, FEBRUARY 22. Modern Projectiles. Advancement in the Navy.

FEBRUARY 29. Proposals for the Construction of a Submarine Boat. J. L.

SOCIÉTÉ DES INGÉNIEURS CIVILS.

OCTOBER, 1895. Experiments on the Consumption of Steam in the Laval Turbine. Electric Tramways with Underground Cables.

NOVEMBER. Electric Appliances in Railway Traffic. Increase of Speed in Express Trains in France. The Use of Glass in Electrical Industry.

DECEMBER. The New Chapsal Electro-pneumatic Brake. Resistance of Sandy Soils to Vertical Loads and to their own Weight. J. L.

REVUE DU CERCLE MILITAIRE.

NOS. 50 & 51, DECEMBER 14 & 21, 1895. The New Regulations for the German Cavalry (see preceding numbers).

NO. 1, JANUARY 4, 1896. The Pantometric Compass-guide. The German Imperial Manœuvres judged by an Englishman.

NO. 2, JANUARY 11. The Complementary Officers in the French Army. The Pantometric Compass-guide (cont.).

NO. 3, JANUARY 18. The Italians in Erythrea. A New Process of Disinfection in the Prussian Army.

NO. 4, JANUARY 25. Recruitment in the English Navy. The Supplementary Officers. The Pantometric Compass-guide (cont.).

NO. 5, FEBRUARY 1. The Italians in Erythrea (with map). The Schoedelin Quadricycle. Fire Engine (with photographs).

NO. 6, FEBRUARY 8. The Supplementary Officers (end). The Pantometric Compass-guide. The English Naval Situation.

NO. 7, FEBRUARY 15. Preserved Meat for the Army. The Automatic Colt Gun (with photographs).

NO. 9, FEBRUARY 29. Opinion of General Dragomiroff of the French Soldier. J. L.

REVUE MARITIME ET COLONIALE.

DECEMBER, 1895. Accurate Reckoning of the Position of the Ship at Sea by Means of any Two Altitudes. Use of Photography in Oceanography. The War between China and Japan. Deductions drawn from the Battle of Yalu and the Japanese Maritime Operations.

The following points drew principally the attention of the Japanese officers at the battle of Yalu: 1st. The importance of uniformity of speed in vessels composing the same squadrons. 2nd. The danger of keeping on deck spare ammunition for R. F. guns. 3rd. The danger presented by torpedoes when above the protective deck at the moment of launching. 4th. The risk of fire arising from wooden frames or inflammable fittings on board of vessels. 5th. The trouble caused by the escape of smoke and gases from funnels when pierced by the enemy's projectiles.

The Bouvine's Electric Apparatus. Firing upon Concealed Positions. Diseases among Sailors and Nautical Epidemics.

JANUARY, 1896. A Note on the Capsizing of Torpedo-boats. Geometry of Diagrams (cont.). About Collisions at Sea.

FEBRUARY. A Study of the English Torpedo-boat Destroyers. The English Naval Manœuvres of 1895. Diseases among Sailors and Nautical Epidemics (cont.). J. L.

LE MONITEUR DE LA FLOTTE.

No. 48, NOVEMBER 30, 1895. Ordering Capitaines de frégate (lieutenant-commanders) to Sea.

Heretofore a captain had the privilege of selecting his executive officer (capitaine de frégate). A recent decree decided that in the future flag officers may select members of their personal staff from a general list of sea duty kept at the Department in Paris, such selection being subject to the approbation of the Minister of Marine. From the above provision are excepted capitaines de frégate detailed on board the school-ships Borda, Ephigénie, Couronne, Algésiras, Battalion of Fusileers and School of Naval Engineers (mécaniciens de la marine). The decree has been diversely commented upon in the Navy.

No. 50, DECEMBER 14. The Superior School of War in the Navy.

No. 51, DECEMBER 21. Naval Engineers (officiers mécaniciens).

No. 52, DECEMBER 28. The Fournier Cruiser.

Under the title, "La Flotte Nécessaire," Adm. Fournier has published a very interesting work, treating as it does of questions that are most vital to the Navy.

No. 1, JANUARY 4, 1896. Official Publications of the Navy.

The French Minister of Marine, M. Lockroy, has just addressed a circular to all the navy-yards touching the advisability of creating an official publication to be called the "Revue Maritime de l'Etranger," resembling very much our own Bureau of Intelligence's publications.

No. 2, JANUARY 11. The Superior School of War Afloat.

No. 4, JANUARY 25. Apropos of the Estafettes.

This is the new name by which are designated the high-speeded crafts that are to keep open communication between the scouts (Eclaireurs) and the main body of the squadron.

Nos. 5, 6, &c. Homogeneity of the Fleet. English Private Ship-yards in 1895. Speed of Torpedo-boats.

No. 9, FEBRUARY 29. Down with the Superstructures.

No. 10, MARCH 7. On the Means of Lessening the Consequences of Collisions at Sea. J. L.

RIVISTA MARITTIMA.

DECEMBER, 1895. The Auxiliary Navy. Study of a Diagram of the Structural Strength, Stability and Trim of Ships. 20 Years of the History of the Sicily Neapolitan Navy. The Mediterranean Military Situation. The Prorogation of the Law of the Mercantile Navy. On the Solution of the Ballistic Problem (supplement to the note published in the August-September number).

JANUARY, 1896 (with supplement). The Belleville and Lagrafel-d'Allest Boilers. The Naval Drama in the Extreme East.

FEBRUARY (with supplement). Electric Alternative Currents and their General Study in Connection with the Geometric Process. Sportive Navigation (yachting). The Belleville and Lagrafel-d'Allest Boilers (cont.). J. L.

RIVISTA DI ARTIGLIERIA E GENIO.

NOVEMBER, 1895. Project of a New Piece of Ordnance (3 plates). The Amedeo di Savoia Hospital for Infectious Diseases at Turin. Firing Preparations in the French Coast Batteries. One Correction in Shrapnel Firing.

DECEMBER. Project of a New Piece of Ordnance (end).

JANUARY, 1896. On the Resistance of Air upon the Flight of Projectiles. Tactical Drills in Infantry and Artillery Fire. Photographing of Moving Projectiles. The Resistance of the Gun studied in relation to the Forms of Projectiles. J. L.

BOLETIN DO CLUB NAVAL.

OCTOBER, 1895. The Naval Technical Institute. The Naval Dock-yards.

NOVEMBER. The Naval Dock-yards. The Longridge Formulas for determining the Highest Pressure and Energies when using Smokeless Powders. The Torpedo-boat Destroyer Sokol. Notes on Astronomy. A Study of the Electric Gyroscope.

JANUARY, 1896. Note on the Mendeleef Pyrocollodium. New Smokeless Powder. The Longridge Formulas, etc. (cont.). Notes on Astronomy (cont.). A Study of the Electric Gyroscope (cont.). A Vocabulary of Powders and Explosives (cont.). J. L.

REVISTA MARITIMA BRAZILEIRA.

JULY-SEPTEMBER, 1895. The Maxim Gun. Rectilinear Trigonometry. Remarks on Modern Naval Tactics. The Protected Cruisers Minneapolis and Olympia.

OCTOBER. The Torpedo-boat Sokol. Plane Trigonometry. Description of the Vessels composing the Argentine Squadron.

NOVEMBER-DECEMBER. The Submarine Goubet II. Description of the Vessels composing the Chilean Squadron. Vessels of other South American Nations. A Note on the Construction of Guns. Rectilinear Trigonometry. J. L.

REVISTA TECNOLÓGICO-INDUSTRIAL.

NOVEMBER, 1895. A Note relative to the Conditions and Power of Resistance in Narrow-gauge Roads, and especially in the 0.750m. Roads.

DECEMBER. Altimetry: Measurement of Heights by Means of the Barometer, Hipsometer, and Photogrameter; Heights of several Spots in Catalonia. Argon.

JANUARY, 1896. A New Algorithm. Shaftings for Sampere y Roca Machinery.

FEBRUARY. A New Algorithm. Tussah Silk. Development of the Experimental Study of the Steam Engine. J. L.

REVIEWERS AND TRANSLATORS.

Lieut. J. M. ELLICOTT, U. S. Navy. Lieut. H. G. DRESEL, U. S. Navy.
Prof. JULES LEROUX.

ANNUAL REPORT OF THE SEC. AND TREAS. OF THE U. S. NAVAL INSTITUTE.

To the Officers and Members of the Institute:

Gentlemen:—I have the honor to submit the following report for the year ending December 31, 1895.

ITEMIZED CASH STATEMENT.

Receipts during Year 1895.

Items.	First Quarter.	Second Quarter.	Third Quarter.	Fourth Quarter.	Totals.
Dues	$721 00	$651 00	$315 00	$409 94	$2096 94
Subscriptions	219 84	216 95	108 18	99 30	644 27
Sales	121 16	87 56	16 65	117 55	342 92
Interest	73 73	18 00	36 50	140 82	269 05
Advertisements	334 49	70 00	70 00	70 00	544 49
Binding	7 00	14 46	3 00	5 00	29 46
Foreign exchanges	05	10	. .	. .	15
Cash on checks given	7 00	. .	22 00	. .	29 00
Life membership fee	. .	. .	30 00	30 00	60 00
Profit and loss	. .	. .	. .	3 00	3 00
Totals	$1484 27	$1058 07	$601 33	$875 61	$4019 28

Expenditures during Year 1895.

Items.	First Quarter.	Second Quarter.	Third Quarter.	Fourth Quarter.	Totals.
Printing	$1074 64	$461 38	$560 82	$527 89	$2624 73
Salaries	300 00	186 80	413 20	300 00	1200 00
Postage	50 83	39 96	35 40	43 92	170 11
Expressage	4 94	5 00	4 80	4 20	18 94
Freight and hauling	8 62	2 20	5 50	2 73	19 05
Binding	12 19	. .	34 20	. .	46 39
Office expenses, stationery	40 20	2 60	6 78	2 00	51 58
Telegraph and telephones	25	75	. .	30	1 30
Gold medal	14 38	. .	. .	. .	14 38
Prize	100 00	. .	. .	. .	100 00
Check furnished	7 00	. .	. .	. .	7 00
Business trips, Secretary and Treasurer	. .	1 75	2 50	1 80	6 05
Engraving medal, box, etc.	. .	6 25	. .	. .	6 25
Checks given for cash	. .	. .	22 00	. .	22 00
Insurance	. .	. .	8 40	1 89	10 29
Purchase of bonds for Reserve Fund	. .	. .	113 00	. .	113 00
Totals	$1613 05	$706 69	$1206 60	$884 73	$4411 07

SUMMARY.

Balance of cash unexpended for year 1894	$4815 78
Total receipts for 1895	4019 28
Total available cash, 1895	$8835 06
Total expenditures for 1895	4411 07
Cash unexpended January 1, 1896	$4423 99
Cash held to credit of reserve fund	79 89
True balance on hand January 1, 1896	$4344 10
Bills receivable for dues 1895	714 00
" " " back dues	999 83
" " " binding	36 20
" " " subscriptions	86 75
" " " sales	19 07
Value of back numbers (estimated)	2000 00
" " Institute property	100 00
Total assets	$8299 95

The liabilities of the Institute consisted on January 1st of the bill for printing No. 76, which had not been delivered on that date.

RESERVE FUND.

United States 4 per cent. Consols, registered	$900 00
District of Columbia 3.65 per cent. registered bonds	2000 00
Coupon bonds	550 00
	$3450 00
Cash in bank uninvested	79 89
Total Reserve Fund	$3529 89
Number of new life members	1

MEMBERSHIP.

The membership of the Institute to date, January 1, 1896, is as follows: Honorary members, 6; life members, 105; regular members, 589; associate members, 191; total number of members, 891.

During the year 1895 the Institute lost by death, resignations, and dropped, 40 members. 52 new members' names were added to the rolls—46 regular, 6 associate; 1 regular member became a life member.

MEMBERS DECEASED SINCE JANUARY 1, 1895.

LIFE MEMBERS.

Allen, R. W., Pay Inspector, U. S. N., November 6, 1895.
Centre, Robert, April 16, 1895.
da Gama, L. F. Saldamha, Admiral, Brazilian Navy, June, 1895.
Lyeth, C. H., Lieutenant, U. S. N., March 8. 1895.
Slack, W. H., October, 1895.

Regular Members.

Almy, J. J., Rear-Admiral, U. S. N., May 16, 1895.
Gilman, A. H., Pay Director, U. S. N., May 21, 1895.
Gorgas, A. C., Medical Director, U. S. N., June 29, 1895.
Elder, E. A., December 4, 1895.
Poe, C. C., May 18, 1895.

Associate Members.

Dagron, J. G., 1895.
Morgan, C. Leslie, May, 1895.

The Institute had on hand at the end of the year the following copies of back numbers of its Proceedings:

Whole No.	Plain.	Bound.	Whole No.	Plain.	Bound.
1	107	....	39	237	1
2	244	....	40	37	115
3	57	....	41	261	19
4	145	....	42	110	19
5	120	....	43	160	3
6	2	....	44	62	10
7	4	....	45	43	19
8	33	....	46	51	19
9	37	....	47	33	19
11	213	....	48	52	18
12	53	....	49	20	17
13	2	....	50	64	17
14	4	...	51	37	18
15	....	....	52	57	16
16	228	....	53	160	34
17	1	....	54	5	4
18	107	....	55	57	17
19	111	....	56	514	55
20	128	1	57	23	20
21	224	1	58	5	7
22	269	1	59	19	9
23	179	1	60	1	1
24	189	1	61	192	18
25	1099	43	62	152	16
26	214	90	63	235	30
27	302	27	64	36	18
28	4	15	65	129	18
29	210	9	66	10	16
30	249	4	67	14	15
31	40	53	68	203	9
32	19	173	69	207	16
33	12	162	70	217	18
34	2	....	71	226	16
35	141	5	72	239	19
36	280	29	73	233	19
37	202	24	74	236	19
38	250	1	75	230	19

1 Vol. X., Part 1, bound in half morocco.

Very respectfully,

J. H. Glennon,

Lieutenant, U. S. Navy, Secretary and Treasurer.

OFFICERS OF THE INSTITUTE.

President.

REAR-ADMIRAL S. B. LUCE, U. S. NAVY.

Vice-President.

CAPTAIN PHILIP H. COOPER, U. S. NAVY.

Secretary and Treasurer.

*LIEUTENANT H. G. DRESEL, U. S. NAVY.

Board of Control.

*Commander EDWIN WHITE, U. S. Navy.
Lieut.-Commander B. F. TILLEY, U. S. Navy.
Lieut.-Commander CHARLES BELKNAP, U. S. Navy.
Lieutenant C. E. COLAHAN, U. S. Navy.
Lieutenant J. P. PARKER, U. S. Navy.
Professor N. M. TERRY, A. M., Ph. D.
Lieutenant H. G. DRESEL, U. S. Navy (ex-officio).

*Lieutenant J. H. Glennon, U. S. N., tendered his resignation as Secretary and Treasurer on February 12, 1896. The Board of Control elected Lieut. H. G. Dresel, U. S. N., as Secretary and Treasurer, and elected Commander Edwin White, U. S. N., as a member of the Board of Control.

There is another difficulty under which an apprentice labors, and that is—too much is expected of him by the officers, when he is transferred to a general service ship; and the officers must forget that what training the boy has had is merely a drop in the bucket.

It has not been long since the writer saw how little exercise in seamanship is given both the men and apprentices in a squadron of modern vessels. During ten days, pulling boats, other than the barge and dinghy, were not used, except on one day when some racing took place. Steam launches were used for the reason, as stated by the captain of a fine new ship, that it was less trouble and quicker to get ashore.

A study of the systems of enlisting and training apprentices in foreign services, especially those of England, Germany, and France, will furnish food for thought. It must, however, be recognized that there is a great difference between the people of the United States and those of Europe. In most foreign services enlistments are compulsory, and it is not particularly necessary to offer any inducements, or rewards for service, or give good pay. In a republican form of government, especially that of our own, which differs materially from others, voluntary enlistment of boys and men must be produced by well-found attractions.

The United States is a peace-loving country, and her people are domestic; not yet fully developed, there are grand inducements in all branches of civil life, in fact there is an opening for every young man. There is always a demand for talent, industry, sobriety, and steadfastness. The people of the United States are patriotic, but their patriotism is that of the civil class, which is the love of the country and her institutions, and her protection in case of need.

For the Navy, then, the inducements for enlisting boys and young men must be those of positive advancement, fulfilment of ambition, with no degradation of social status in an ordinary sense. To a great degree these inducements are held out to those entering the Naval Academy; but are they for an American boy enlisting as an apprentice?

As has been often said, we cannot, in the United States, depend upon patriotism in times of peace, nor the love of the sea, for recruiting seamen. If the comparatively little pay and

uncomfortable sort of life of seamen be compared with the higher pay and comfortable homes of a similar class of laboring men on shore, if there be no advancement, beyond a certain point, to the top of the ladder made possible for them as a reward for industry, natural talents, good conduct and efficiency, the best boys and men will not enlist; and for those who do, what becomes of ambition? If there is no ambition in a man, what can we expect of him? Will such a one ever become the modern seaman we want to-day?

The statement cannot be made too emphatic that, for the American Navy, inducements for enlistment must equal those for civil trades and professions; the best in the land must enlist. We do not want those who are incapable of doing anything on shore, nor those who, by reason of their unreliability, cannot keep a position on shore. Some may state that the woods are full of men willing to enlist in the Navy. Many men are willing if proper inducements and comforts are offered; others we do not want at any price. There are now many good men in our service, both American and foreign born, and a large number who are not good men.

It will now be said, that among the inducements for boys to enlist as apprentices there should be the possibility of rising from an apprentice to admiral, and this must be the greatest spur for their ambition. We are a free and independent people, forming a nation in which all alike are equally free-born; and such a people that the humblest boy can rise and become President, Commander-in-Chief of the Army and Navy. Would it then be too unreasonable for an apprentice boy to rise and become an admiral? Some may say this is theoretically a nice way of arguing, but it can be practical also.

There is too much of that wide gulf existing between the enlisted man and the officer. Not that it is advocated that there should be familiarity between the two, or any lack of discipline. There is the military difference which *must* exist, and there is the social difference, for the time being, that must exist for military reasons. In time of war, even in peace, it has often happened that men of good social status are privates under the command of more humble-born; discipline was maintained, and mutual respect existed. It might be suggested that the grand inducement, once offered, may tend to injure any appren-

tice system, as it is claimed that it did once before, when the entry as an apprentice was made the road to a commission.

The method that will be proposed in this article is not the same. There will be two distinct roads to a commission in the line of the Navy, one through the Naval Academy, the other through the training squadron. The apprentice must rise through seaman, petty officer, and warrant officer, to a commissioned officer *without* ever going through the Naval Academy, as formerly done, and his commission will be the reward of his own exertions and worth. The service will be guarded by suitable examinations and reports. The system which is here proposed is the result of observations on board our training ships, combined with some study of foreign systems, and the thought created by the numerous essays and discussions written on kindred subjects.

The greatest inducement for parents sending their boys into the Navy having been touched upon, the next point is their enlistment and training. One of the most important parts of the training is the possession of suitable training ships. Allied to these will be a slightly different organization of the seaman branch of the Navy, as necessary to carry out effectively what is an American system—a *civil service* system, as it were; merit, morals, and good conduct to be the requirements for promotion in all cases.

Enlisting Apprentices, and Inducements.

It must be quite evident that when only ten to fifteen per cent. of the naval apprentices enlisted remain in the service, something is wrong with the system.

The source of supply of seamen for our modern Navy should be the training squadron, with possibly a limited enlistment of young men from 21 to 25 years of age, who could also be given a short course of training, as will be suggested later on.

The average annual waste of seamen in the English Navy is from 11 per cent. to 14 per cent. In our own service in 1892, out of 8,250 men and boys, 1,614 were discharged for disability, services not required, at own request, requests of commanding officers, bad conduct, illegal enlistments, inaptitude; 1,260 men deserted, making a total waste of 2,874 (not including deaths). In 1893, similar figures bring the waste to 2,719. Taking 2,800

as the waste out of 8,250, there is a percentage of over 32, which is unhealthy, being nearly three times as great as that of England, and, of course, would not last under more favorable conditions. The average number of desertions of men in 1891, '92 and '93 was 970, which is 13 per cent. of 7,500. The average number of apprentices who deserted in 1891, '92 and '93 was 330, or 44 per cent. of 750, the whole number allowed at that time.

Of those men discharged in 1891, '92 and '93, about 12 per cent. had requested it, and this, with the 13 per cent. who deserted, makes 25 per cent. of the enlisted force who left the service because dissatisfied in some way or other. Thus, 25 per cent. of the trouble of training the men, as well as 25 per cent. (nearly) of the expense, was, to a great extent, uselessly expended. These figures are a trifle large, due to some men of the Coast Survey and Fish Commission being discharged for various reasons, but that number is not large. In 1892 and 1893 the average number of men holding continuous-service certificates was 1,640, or about 22 per cent. of 7,500, and represented those contented with the service and satisfactory in ability and conduct.

The figures for 1894 and 1895 will show an improvement, which, I believe, is due to good laws relating to the men, such as "discharge by purchase," the offer of a home, or partial retirement after twenty years' faithful service, better quarters on board ship, permanent appointments for petty officers, and probably to greater interest in the new Navy. Taking the figures for 1895, 813 men and 124 apprentices were discharged for disability, services not required, at own request, request of commanding officer, bad conduct, inaptitude, discharge by purchase, etc.; 715 men and 173 apprentices deserted, making the waste as follows:—For men, 1,528, or 18 per cent. of 8,500; and for apprentices, 292, or 20 per cent. of 1,500 (supposing the above numbers represent the total enlisted force), or 18 per cent. of the 10,000 men in the Navy. Thirty-one per cent. of the men held continuous-service certificates. Thus the waste is still considerably greater than that of the English Navy in 1878.

Taking the waste as 12 per cent. of the total enlisted force, under fair conditions, 1,200 new men would be required each year, of which some 400 would be required for the engineers' force.

It would be fair to presume that 75 per cent. of the apprentices would remain in the service after reaching the age of 21 years, under a satisfactory system. This percentage would yearly amount to about 200 out of the 1,500 apprentices in the service, and would represent an annual enlistment of about 400 boys.

In the case of the officers of the Navy, taking the line, engineer, and marine corps, numbering about 1,000 on the active list, the annual waste is about 4 per cent. or less; and, in order to supply this waste, about 300 cadets are kept in training, or one-third of the total number of officers concerned. Should such a proportion obtain in the enlisted force of the Navy, we should have about 3,500 apprentices instead of 1,500, and, I believe, it would be economy in the long run, not only in the matter of expense, but also in efficiency, to make such an increase. In the English Navy, with 20,000 men in the *general* service, there are 5,000 to 5,500 apprentices.

With a reorganization of the seaman branch, and some further inducements as are proposed in this article, such that a larger number of men would obtain continuous-service certificates, or would re-enlist, the above-proposed number of apprentices would be sufficient to supply the annual waste in the seaman branch, or from 700 to 800 a year, allowing 12 per cent. for the general percentage of waste. As to recruiting the engineers' force, it is better to enlist men directly from civil life who have already had some experience on shore or at sea in similar capacities; and one modern vessel, as part of the North Atlantic Squadron, might be assigned for their instruction.

The present regulations concerning the enlistment of boys are very good, if strictly carried out. They are sections 1418, 1419 and 1420, Revised Statutes, and some rules established by the Honorable Secretary of the Navy; and are briefly as follows: "Boys between the ages of 14 and 17 years, with the consent of their parents or lawful guardians, are enlisted to serve until 21 years of age. No insane, intoxicated person, nor a deserter from the naval or military services shall be enlisted. A boy enlisting must satisfy an examining board of officers that he is of robust frame, intelligent, of perfectly sound and healthy constitution, free from any physical defects or malformation, not subject to fits or dizziness; is able to read and write English." No boy convicted of crime can be enlisted. In special cases,

where a boy shows general intelligence, and is otherwise qualified, he may be enlisted notwithstanding his reading and writing are imperfect.

The minimum age and physical standards are now such that mere children are often enlisted, and even if remaining six months at the training station, and six months on board the training ship, they are often too small to draft to a cruiser so as to be of any value. Again, there are boys, large and strong physically, who have no education and are not overburdened with intelligence, often found on board the training ship.

It has been found in the English Navy, where there are over 5,000 boys, of whom 2,500 are in special training, and in which service excellence in training her seamen has been attained, that the best age to enlist boys is from 15 to 16½ years, the latter limit not to be exceeded. For a boy 15 years old the minimum height is 5 feet, chest-measure 30 inches, weight about 100 lbs.; compared with this in our service, a boy 15 years old must be 4 feet 11 inches tall, chest-measure 27 inches, weight 80 lbs., and for boys 14 years old, 4 feet 9 inches tall, 26 inches chest-measure, weight 70 lbs.

It can very easily be seen that too early entry, or too low physical standard, works to serious disadvantage when boys are transferred to the general service ship to fill up her complement; such boys cannot do the work of men.

Again, in the English service it is found that boys over 16½ years, especially such as cannot pass the mental test, are too mature to be readily adapted to seafaring life; for minds so long dormant are less receptive to the knowledge that a modern seaman must possess. A fine physique will not of a right pass such boys into the service.

The long experience of English officers seems to bear out the above observations.

There is another thing: not sufficient attention is paid to good character and moral qualifications. Although boys may not be convicted of any crime, yet they can come from a reformatory, and such boys, incorrigible by their parents, should not be allowed in the service. The training squadron is no place for incorrigible boys, of whom parents or guardians wish to rid themselves; time and patience are too precious to waste on them. Few such boys remain in the service, simply because they are discharged, or desert, not, however, until six months or a

year has been thrown away on them. Then there is a great deal too much of this business of step-fathers and step-mothers forcing their boys to enlist in the Navy. Such boys may be intelligent, but they will not try to learn, nor will they do duty properly. We want boys who *want* to go in the Navy and make it a profession. They will succeed, and a few may be found in every draft. They grow up and make some of our best petty officers. Nothing is more exasperating to a divisional officer than to get hold of a boy who does not want to learn, or one of no intellect; hours of patient instruction are given, which goes in at one ear and out at the other. There must be a more severe weeding-out system at the training station, so that every boy coming on board the training ship means, and is fit for, business. There may be an old saying that "boys will be boys," but there is another one, "there are boys and there are *boys*." The government is paying each one nine dollars a month, and thirty cents per day for rations, to learn and remain in the service. It is suggested that inducements and regulations for enlisting somewhat similar to the following be adopted:

1. American-born boys, from 15 to 17 years of age, with the written consent of their parents or guardians, who are robust, healthy, undeformed, sound, intelligent, and of good character, may enlist in the U. S. Navy as apprentices, to serve until 21 years of age.

2. No boy, insane or intoxicated, possessing any inherent weakness, or disease affecting the health or longevity, or a deserter from the naval or military service of the United States, shall be enlisted.

3. No boy between the ages of 15 and 17 years whose height is less than 5 feet, chest measurement under 28 inches, weight under 100 lbs., even if otherwise qualified, shall be enlisted as an apprentice.

4. The enlistment of boys shall be entirely voluntary, and each boy shall, under oath, so state, as well as his parents or guardians.

5. Each apprentice shall be made to understand the meaning of the shipping articles, and take the following oath:—I swear (or affirm) that I will support the government of the United States, and will obey all lawful orders of my superior officers as long as I remain in the service of the United States; and I do renounce all allegiance or fidelity to any foreign power,

prince or potentate, and will remain loyal to the United States as long as a citizen thereof; under the pains and penalties that law may prescribe.

6. Each apprentice, on enlisting, shall be furnished gratis such outfit of clothing as may be prescribed by regulation.

7. Any apprentice, with the written consent of his parents or guardians, may purchase his discharge after six months' service, provided he refunds to the government all pay he may have received, and the value of the clothing originally furnished him, if approved by his commanding officer, as well as by the Navy Department.

8. An apprentice may, by his fidelity, intelligence, industry, obedience, and good conduct, after having served his minority, undergoing suitable examinations, and passing through the grades of seaman, petty officer, and warrant officer, in the U. S. Navy, be eligible to promotion to the lowest grade of commissioned line officer, provided he undergoes the same examination as the graduating class of naval cadets, and further provided that he shall be examined with the graduating class of the year.

9. One-tenth of the vacancies occurring each year, in the lowest commissioned grade of line officer, shall be reserved for the promotion of warrant officers. No greater number of warrant officers, who are ex-apprentices of good standing, shall be examined each year than have been suitably recommended to the Navy Department by commanding officers of ships, squadrons, or stations. Those passing satisfactorily shall, in the order of their standing, be assigned the vacancies reserved; but no such vacancy, if not filled by warrant officers, shall hold over from one year to the next, but shall be filled by the naval cadets.

10. The only grades of warrant officer eligible for advancement to a commission shall be those of boatswain and gunner, and none but ex-apprentices shall be eligible to promotion from warrant officer to the lowest commissioned grade of the line, and provided that such warrant officer shall have served at least six months at sea as warrant officer, and is not over 30 years of age.

11. A warrant officer, having received a commission in the lowest grade of the line of the Navy, shall take rank next after the last naval cadet commissioned that year, and shall, thereafter, be in the regular line of promotion.

12. All grades of warrant officer shall otherwise be filled as now prescribed by law.

Training of Apprentices.

Admiral Luce says, in his article on Naval Training (No. 3, 1890, U. S. N. I.), "The first essential in organizing a system of training is to know exactly what is to be produced. The brain, nerves, and muscles must all be trained, one is essential to the other." We want, above all things, able *petty officers*, and educated, reliable seamen for our modern Navy.

There is no profession where more manly traits are called for than in that of the seaman. He must be possessed with readiness of resource, quickness to understand, and adaptation to the demands of the moment. He is not the old sailor, who was very dependent, requiring always to be looked after. Self-reliance and resolution must be a part of his nature. In fact, he must be more like other men on shore, who earn their living by the sweat of the brow.

What will be the efficiency of a modern battleship if the guns, torpedoes, and machinery are in the hands of *untrained*, unskilled, possibly unpatriotic hands? A *trained personnel* is necessary, and the most important part of it is the petty officer, who must first be a *seaman*. Now the man possessing the brightest, quickest brain, the most trained in muscle, nerve and will-power, will naturally make the most efficient fighting seaman. The subject, then, being of so much importance, we should begin at the bottom of the ladder with the apprentice boy and make him the seaman that Americans will always be proud of.

As soon as practicable, after enlistment, apprentices should be transferred to the training station, and *there* furnished with their outfit of clothing, to be made to measure by a tailor. It often happens that ready-made clothing, issued by the Pay Department, does not fit, and is not strictly regulation, due to changes in uniform regulations, old clothing being issued first until the supply is exhausted.

The matter of always being *strictly in uniform* should be a strong point in the training of apprentices. There are too many men in the service who wear non-regulation clothing, and they are found right on the training ship, unless steps are taken at once to prevent it.

After the boy joins the training station, the first things to be taught him should be how to lash his hammock, how to wash himself and his clothing, and that "cleanliness is next to godliness."

The present system of instruction at the Naval Training Station, Newport, R. I., as instituted by Captain Bunce, U. S. Navy, when in command there, is excellent, and there are evidences of the good effects shown in the apprentices now drafted to the training ships. By General Order No. 257, of Dec. 16, 1880, the station was established on Coaster's Harbor Island, near Newport, which the State of Rhode Island had presented to the Government. It might be said the foundation of the present system of training began there. It is a great pity the station could not have been located further south, say on the Chesapeake Bay, open all the year, whereas the climate of Newport in winter is often beastly.

Apprentices are drafted from the receiving ships to Newport from time to time, and are there assigned to a division. The complete division is made up of 108 boys, forming 3 companies of 36 each; each company is divided into 2 sections of 18 each, as provided in the Infantry Tactics. A commissioned officer is assigned the command of a division, and has for his assistants three petty officers, a schoolmaster, and two masters-at-arms, say, and section masters of seamen-gunners, when practicable, who command the companies and sections, and are with them and responsible for them all the time.

The instruction consists of elementary seamanship and gunnery, reading, writing, arithmetic, geography, history of the United States, and history of the Navy. Lectures on various subjects pertaining to the Navy, foreign countries, seaport towns, etc., have been prepared and are delivered. They are instructive and of great interest to the boys.

The system is well described in the annual reports of the commandant of the training station in 1892 and 1893.

After a period of instruction of six months at the station, a six months' cruise is made on the cruising training ship.

The great feature of first having the boys on shore is that they have clean barracks, plenty of room, fresh air, fresh water to wash with, and that they are *constantly* under surveillance.

The only comments that might be made on the system used at the training station are that the apprentices should remain at the station not less than six months, and if possible from nine to twelve months, the first part of the course being devoted more especially to school instruction, setting up, and gymnastic exercises, for the purpose of developing the mind and body at

the start. More attention should be paid to schooling, infantry and artillery drills, sword exercise, boat exercise, and less to seamanship and gunnery. My reason is that seamanship and gunnery can better be taught and learned on the training ship, where schooling, infantry and artillery exercises cannot be so well attended to. The main idea, I should say, of the instruction at the training station on shore is more to *prepare* the mind and body for what comes afterwards. A boy will have little schooling after he leaves the station; his education for life may depend upon it. So let one thing at a time be thoroughly done. A good opportunity for weeding out the undesirable boys will then be given, and the service will be benefited thereby.

Six months having been devoted to schooling, developing, and *military* exercises, a beginning on seamanship might be made, and, for that purpose, one or two brigs, of about 500 tons displacement, should be provided. A division (108) could go out for the day, and have constant drill at sails, spars, heaving the lead, steering, working ship, anchoring, getting up anchor, etc. This is done in the English service, where there is a brig for each training ship, and no one who has seen those little brigs going in and out of port every day of the week, weather permitting, has failed to be favorably impressed. This latter work will be of great value to the boy when he comes on board the cruising training ship, and this training will also form the basis for the final weeding out at the station.

The next part in the boy's training is the cruise on the training ship, which is of the greatest importance; on it will turn the like or dislike of the boy for the service.

Training Ships.

On board the training ships the apprentice gets his first real impressions of the Navy, and here he should receive the most important part of his *professional* education, which must be *practical.* He is, by his schooling and previous drill, well qualified for a good start.

Too much attention cannot be paid to the size, rig, and fittings of the training ship, and especially in regard to the facilities for instruction in gunnery, torpedoes, seamanship, electricity, etc. (all practical).

At the present time we have the Alliance and Essex, two steamers, barque rigged, of 1,375 tons displacement, each of

which takes out, twice a year, 108 apprentices, and a crew of men and petty officers of 85, making a total of 193 people living forward of the mast. These ships have no gun decks. The only berthing and living spaces are the berth-deck forward of the boilers, poorly lighted and ventilated, where the 108 boys have billets, and where hammocks hang on the hooks like sardines in a box; and under the topgallant forecastle, where all the men have billets. Every one is very much crowded, and in bad weather the only place to go for the greater part of the day is under the topgallant forecastle, as the berth-deck must be kept clear for the purpose of cleaning up and setting mess tables. The ships are provided with a modern battery of 4", 6 pdr. and 1 pdr. R. F. guns, and this is about the only modern thing on board. There are few or no facilities for instruction, no models, etc., and but little of anything provided.

The vessels are kept running, and that is about all. There is no reason why every boy should not become disgusted with the service, so far as his life on the present training ship is concerned. It is difficult to turn out good material under present circumstances (I mean in a modern sense).

It is quite evident that, in order to make a success of training apprentices, at least two suitable ships for the training squadron be provided. In the English service, where better ones are provided, it is there even found that boys are not as well developed as they should be, and it is said to be due to the overcrowding of their training ships.

It must be remembered that boys are growing, and need more care than "old salts," better food, and greater facilities for exciting interest and stimulating the muscles, brain and nerves. No amount of living on board a crowded vessel, with no pleasures and few comforts, will make a boy love the sea.

Quite recently the writer was enabled to see the kind of vessels the Germans have for training their men and midshipmen, when three sheathed iron steamers, full ship rigged, each of about 2,900 tons displacement, came in port (S. M. S. Stein, Stosh, and Gneisenau). These vessels carry crews of over 400, and seem to be well suited for the purpose of training, though not quite modern.

In determining the type of ship we want, I will quote a little. Dr. F. La Grange says, "It is incontestable that certain faculties of the soul come into play in bodily exercise to excite the con-

traction of muscles and to co-ordinate movements; it is also incontestable that those faculties are improved and developed by exercise. The faculties which preside over the co-ordination of movements are developed by the performance of difficult exercises, and their improvement endows a man with the quality we call skill." Now can any one admit that such exercise can be obtained on a modern man-of-war? Gymnastic exercise, boxing, etc., are very good in a way, and possibly sufficient for men, but not for the boys we want to develop.

Admiral Luce says, referring to the sailing ship, " It is impossible for any young man to go through the school of the topman, and become an able seaman, without having his moral being permanently affected by it. Indeed, it is well known that such an experience does affect character, and has endowed the sailor with those high qualities of self-reliance, endurance, courage, and patience under difficulties, which have always characterized him."

A sailing ship would then seem to be still a very desirable thing for the training of boys, and in addition to this, we combine the knowledge gained of useful seamanship, which every *seaman* of to-day ought to know, and what every *sailor* formerly had to know. It is recognized by the best steamship companies that seamen are most easily and efficiently made in sailing ships. England, France, and Germany, countries possessing great modern navies, with skilled men to handle their ships, recognize the value of sails in the early training of boys, both for seamen and officers. If seamanship were all that is now required in training men, we would say the sailing ship (alone) is the proper type; but the training must be for fighting purposes, skill in great, rapid-fire and machine guns, torpedoes, small arms, etc., and the knowledge of modern machinery now used in modern men-of-war, which are mere workshops as well as gun platforms. We must then, in selecting a type of training ship, retain the spars and sails, but provide her with moderate steam power, using a modern type of engine and boilers; with a modern battery, small arms, torpedoes, dynamos, modern appliances, models, etc., as far as practicable. It will then be possible for a modern man-of-war's-man to be turned over to the general service at the end of the practice cruise.

It would be a measure of economy in the long run, and of marked efficiency, if two suitable training ships be built, that they

be so constructed as to render good service in case of war. The vessels at present in use might be returned to the general service, and would be valuable for some time if sent out to the Pacific. Attention is invited to some details in the design and in building of a training ship. A little experience in those used at present and formerly is sufficient to point out the needs.

Type of ship.—Single screw gun-deck steamer, ship rigged to royals, with nearly full sail power, of about the following size: length 220 feet, extreme breadth 40 feet, mean draft 17½ to 18 feet, displacement about 2,200 tons, height between decks not less than 7 feet in the clear, air ports of berth deck to be large and not less than 5 feet above the water. To be built of steel throughout, and the bottom *sheathed with wood* to a convenient height, say the gun deck. There should be a light protected deck, on which would rest the berth deck, and under which would be the "vitals" of the ship. Thus, four decks would be provided, spar deck, gun deck, protected and berth deck, and forward and after orlop decks.

General details.—The engines to be triple expansion, which, with modern boilers, would, under natural draft, be designed to drive the ship at a maximum speed of 12 knots and an economical speed of 8 knots. Donkey boilers should be located in the fire-room for working the steam capstan, dynamos, blowers, flushing pumps, and cranes for hoisting the launches. Evaporating and distilling apparatus, capable of producing 2,000 gallons of fresh water *per diem*, should also be located in the fire-room compartment. The fore and main masts, fore and main yards, and the bowsprit might, for reasons of strength and lightness, be built of steel. The standing rigging should be steel wire rope. The ship should be provided with steam (and hand) capstan, steam and hand steering gear, dynamos, blowers for ventilation, and an ice machine for cooling drinking water. Two bridges should be provided on the spar deck, one aft, for use when under sail (on which might be located the standard compass), and under which would be the hand steering wheel, with steering compasses; one forward, for use when under steam, which would be provided with a chart house, on which would be the steam steering gear, engine room indicators, and a compass. Both bridges should be of such height that a view over the boats would be possible.

The boats should be large enough and sufficient in number

to carry the whole crew with ease, and might consist of three cutters stowed on skids over the quarter deck, between the after bridge and main rigging; two whale boats, which could hang from davits at the ends of the quarter deck boat skids, and could be rigged in, or from davits (folding) on the quarters; one sailing launch and one steam launch, to be stowed on half skids in the waist abreast the smokestack, each to be hoisted by a crane or derrick, worked both by hand and steam power; one gig to hoist aft, one dinghy, and one shell boat (for use of officers), to be stowed in the sailing launch at sea, and to hoist on davits abreast the mizzen rigging in port. The cutters and whale boats might be of the same length, provided with suitable detaching apparatus, and built with oarlocks low enough for boys.

In order that the ship might sail as well as possible, the screw should uncouple well aft, and a false keel of wood, extending one to two feet below the keel of the ship, should be provided.

Battery.—Two 6-inch R. F. guns, mounted on the forecastle and poop on the midship line; two 5-inch and six 4-inch R. F. guns, mounted on the gun deck in sponsons. and as opposites (5" guns forward); six 6-pdr. R. F. guns, two to be mounted in the after cabin, the others between the four-inch guns in suitable sponsons; two 47 mm. revolving cannon, mounted on the forward bridge; two machine guns, mounted on the after bridge; two field 6-pdrs. All guns on spar deck to be provided with shields. Different service mechanisms should be represented in the battery. Boat and field carriages for the revolving cannon and machine guns should be provided. The idea is to have a battery as diversified as possible to give more room for instruction. The latest type of modern small arms should also be provided for instruction, though for drill, older types might be used for economy, as boys give these hard usage.

Torpedoes.—Two torpedo tubes should be provided, one on each bow, with carriages on the berth deck, and located in a roomy, water-tight compartment, which would also be used as a torpedo schoolroom and workshop. One Whitehead and one Howell torpedo should be provided, with spare parts and appliances for use and instruction of apprentices.

Location of quarters, store rooms, etc. On the gun deck.—Aft would be the cabin, divided into forward and after cabins, provided with two staterooms, with adjoining bath rooms and w. c. arrangements, and a cabin pantry amidships, for-

ward of cabin bulkhead. On the port side, forward of the cabin, should be located two roomy staterooms for the executive and navigating officers, with their offices. On the opposite side, and taking up an equal space, should be the library and reading-room, provided with an excellent assortment of books, tables and easy chairs. Forward in the waist on one side between two guns, might be located the armory and ordnance model room, in which should be a good assortment of models of guns, mechanisms, etc., fuses and appliances for the instruction of apprentices. On the opposite side might be located the crew's library. The ship's galleys and bake oven should be located forward in a light, open steel room, amidships abaft the foremast. The crew's water closets would be at the forward extremity, in a compartment, and a special place provided for petty officers. On this deck all the apprentices would have billets. *On the berth deck.*—All that part abaft the mainmast would be given up to the ward room and warrant officers, and divided into four compartments, as follows, beginning aft:—Ward-room bath-room compartment, which would contain bath-tubs, lavatories and water closet arrangements, and should be well ventilated and lighted with an air trunk to the spar deck; ward-room stateroom compartment, in which would be fourteen comfortable rooms opening into a central alley-way, provided with a light and air trunk to the spar deck. Each room should be provided with a ventilator, electric light and suitable furniture; a small stairway might lead to the gun deck; ward-room mess-room compartment, which would run from side to side, be provided with table, sideboard, etc., and a skylight; steerage compartment, in which would be located four warrant officers' staterooms, warrant officers' mess-room, pay office, ward-room and warrant officers' pantries, and a room for stowing officers' rain clothes; into this compartment would lead a hatchway from the gun deck, through which would lead engine-room trunk, and from which would lead a hatchway to the after orlop deck. Forward of the latter compartment would be the berthing space for the men, which should contain an apartment similar to the old steerage for the chief petty officers, a bath-room for the men, sick-bay, wire bag lockers out at the sides and amidships for the crew, and the blowers. The main hatchway should come out just forward of the steerage com-

partment, the fore hatchway forward of the fire-room trunk. The torpedo-room would be located at the forward end.

Under the protective deck.—Beginning aft might be the steering engine compartment, which would end the orlop deck; store-room compartment, where would be located the paymaster's stores, cabin, warrant officers', ward-room officers', and ordnance stores; engine room compartment; fire-room compartment; forward orlop deck, as far as the foremast; fore-peak and collision compartment. The sail rooms and equipment store-rooms should be located on the orlop deck, just forward of the fire-room; they could be converted into coal-bunkers in case of war. The ordinary coal-bunkers could be located outboard of the engines and boilers. Below the orlop decks would be fore and main holds, where would be the wet provisions, water tanks, and ammunition rooms. The dynamo room might be on the after end of the forward orlop deck, next to the fire-room.

Electric plant, located as above, should consist of two similar dynamos of sufficient power to run the incandescent lights and one search light. The dynamo room might be made a little larger than those of modern cruisers, to give more *room* for the instruction of apprentices. The ship should be provided with most of the modern electrical adjuncts, especially the apparatus for signals, as signaling is an important part of the apprentice's instruction; spare material, models and samples of different electric gear should be provided for instruction.

Too much importance cannot be attached to the value of a covered gun deck, for room, health, comfort, as well as a good protected battery platform. It also provides a large school-room for the apprentices, especially valuable in bad weather.

As the above type of ship will not have such high powered engines as the modern racing cruiser, the cost will not be so great, and there will be a great deal more room. The steam power is intended only as an auxiliary to be used in going in and out of port when necessary, or otherwise used in case of necessity; but is of sufficient power to make the vessel a fairly efficient steamer. By having two such vessels built at the same time, probably $450,000 would cover the cost of each exclusive of the cost of the battery.

The importance and value of some such vessels to the training service, to make the latter a success, should be sufficient warrant for Congress authorizing their construction.

THE CRUISE OF THE TRAINING SHIP, AND SYSTEM OF INSTRUCTION.

In the English service, about 16 months are spent in training apprentices before transfer to general service. At the present time our apprentices are, as a rule, transferred at the end of about 12 months. In that short time, one would hardly believe that sufficient instruction and experience can be obtained, when the fact is taken into consideration that but little special instruction is given the apprentice on general service vessels. In addition to the course at the training station, above referred to, a continuous cruise of 10 months would seem to be desirable, thus giving each apprentice from 16 to 22 months' experience.

Admiral Luce says in his article on Naval Training, "The cruise of training ships should always be to foreign ports . . . Hanging around the coasts and inland waters, and anchoring every evening or two, so that all hands may enjoy a night in, is very pleasant, but it is not business . . . By letting the ships cruise singly with a view to their meeting at a certain time under squadron organization for competitive exercises . . . the best results may follow. The spirit of rivalry stimulates each one to do his best." It is easily seen that a foreign cruise is better than one on our coasts for two principal reasons: first, because the boys will take greater interest and will have a chance to see something, getting varied experience, and second, because the great annoyance of applications for leave, and desertion will be avoided.

At present our training ships make two cruises a year, of five months each, to Europe or the West Indies, according to the season, and spend the greater portion of the time actually at sea, but cruise singly. Under the proposed system a long sea cruise is better, as previous preparation at the training station is somewhat modified. As it is at present, shorter cruises, with more time in port, would be of slight advantage.

It is suggested that the two ships cruise singly for the first six months, making a cruise to Europe, leaving the United States about May 1st. About Nov. 1st they would return to Yorktown, Va., or Port Royal, S. C., for *target practice*, spending a month at both stationary and moving practice with the great and secondary guns, and the small arms as provided by regulations. Each boy should have an opportunity to fire a gun of the main or secondary battery, the most proficient in stationary practice to fire at moving practice. This is a very important

part in the system of instruction, as the skill in handling the guns effectively is the most important of a seaman's accomplishments.

About Dec. 1st the two ships should sail together in company for a three months' cruise to the West Indies, and remain in company until the return to the United States and the annual inspection. The apprentices thus gain their final experience in the training ship.

After a leave of absence of about two weeks, such boys as are qualified in every respect for transfer to the general service should be transferred, and the remainder discharged from the service. Two months would then be available for overhauling and repairing the ships for the next cruise. Thus there would be one cruise each year, and the two vessels above suggested would be large enough to take all the apprentices enlisting each year, with the present number allowed by law.

There have been, in general, two systems of instructing apprentices on board the training ships. 1st. Each watch officer was made the head of a department of instruction, being aided by the warrant officers and a schoolmaster for each gun division. In this system each officer instructed and examined all the apprentices in his own department, thus ensuring *uniformity* of instruction, which is an important thing, and the possibility of knowing the backward boys better and giving them further instruction. By a rotation of divisions, and with a sufficient number of assistants, only a small number of boys would be instructed at a time. The second system (the one now employed) is what might be called the "divisional system," in which each division officer instructs his own division in everything. It lacks the greatest advantage of the first system, *uniformity of instruction*, and besides, where all are taught the same things, there should be a division of the labor. Apparently it is unsuited for ship work. On the present training ships there are *no assistants* except the seamen petty officers of the ship, who are supposed to instruct in marlinspike seamanship. These petty officers are not paid for this kind of work, and often perform it reluctantly, and not well.

Experience with both systems is convincing enough, at least under present conditions, that the former is better, and it might be suggested that a similar system be used.

Schoolmasters are very valuable on board a training ship (not *shore* schoolmasters, but men-of-war's-men), and their importance cannot be overestimated. They are more valuable even

than junior officers, as they are in constant charge of, and in contact with, the boys of their own divisions. They perform duties that it is not proper that an officer should perform and preserve the dignity that will always insure ready obedience. An officer must not have too much contact with the enlisted men, a little aloofness is better. The schoolmasters are men paid for the work they do, and if selected with some care, good results will follow. Even if they were allowed, there would be no room for them on board the present training ships.

The following division of the labor of instruction and arrangement is a modification of the first system, and would, I believe, produce good results:

1st watch officer. Head of 1st department of seamanship. Includes rigging, sails, spars, marlinspike seamanship, ship's economy, and models. Assistants: the boatswain, sailmaker, carpenter, and schoolmaster of division.

2nd watch officer. Head of 2nd department of seamanship. Includes boats, lead, log, compass, and rules of the road. Assistants: junior officer of division and schoolmaster.

3rd watch officer. Head of 1st department of gunnery. Includes great and secondary guns and target practice, torpedoes, magazines, ammunition rooms, and models. Assistants: junior officer of division, the gunner, and schoolmaster.

4th watch officer. Head of 2nd department of gunnery. Includes machine guns, small arms, subcaliber and small arm target practice, gymnastics, broadswords, etc. Assistants: junior officer of division and schoolmaster.

5th watch officer. Head of department of electricity and signals. Includes electric plant and signal instruction. Assistants: junior officer of division, schoolmaster, and electricians.

In the daily routine of instruction a certain amount of freedom should be allowed the division officer, and, accordingly, special drills should not, as a rule, be specified in such a routine for each period, that being left to the discretion of the instructor. A whole day should be allowed for a subject for each division, as the mind of a boy will not be confused by varied instruction, and can better retain what is taught than when each period is assigned to a different department of instruction. Thus, there would be five departments of instruction, five divisions of boys, and five days in the week for instruction, allowing a complete rotation for each week. The following routine is based upon the above remarks and those lately used on the ship:

DAILY ROUTINE.

	First Div.	Second Div.	Third Div.	Fourth Div.	Powder Div.
Monday.					
1st Period 9.30 to 10.30	Weekly	routine for	all hands.		
2nd Period 10.45 to 11.45	1st Seamanship	2nd Seamanship	1st Gunnery	2nd Gunnery	Electricity or Signals
3rd Period 1.30 to 2.30	"	"	"	"	"
4th Period 2.45 to 3.45	"	"	"	"	"
Tuesday.					
1st Period	Weekly	routine for	all hands.		
2nd Period	2nd Seamanship	1st Gunnery	2nd Gunnery	Electricity or Signals	1st Seamanship
3rd Period	"	"	"	"	"
4th Period	"	"	"	"	"
*Wednesday.**					
1st Period	Weekly	routine for	all hands.		
2nd Period	1st Gunnery	2nd Gunnery	Electricity or Signals	1st Seamanship	2nd Seamanship
3rd Period*	"	"	"	"	"
4th Period*	Sewing	and mending.	Bag inspec	tion.	
Thursday.					
1st Period	Weekly	routine for	all hands.		
2nd Period	2nd Gunnery	Electricity or Signals	1st Seamanship	2nd Seamanship	1st Gunnery
3rd Period	"	"	"	"	"
4th Period	"	"	"	"	"
Friday.					
1st Period	Weekly	routine for	all hands.		
2nd Period	Electricity or Signals	1st Seamanship	2nd Seamanship	1st Gunnery	2nd Gunnery
3rd Period	"	"	"	"	"
4th Period	"	"	"	"	"
Saturday.					
Forenoon.	Cleaning stations for all hands.				
Afternoon.	At sea, sewing and mending. In port, watch to have liberty, according to class. Holiday.				
Sunday.					
Forenoon.	Commanding officer inspects. Church. Library books.				
Afternoon.	At sea, library books. In port, watch to have liberty, according to class. Library books.				

* In port on Wednesdays all first class boys have liberty.

WEEKLY ROUTINE OF EXERCISES. AT SEA. 1ST PERIOD.

Monday. Sail exercise, or manœuvre ship. All hands.
Tuesday. Stations, arm and away boats, abandon ship, up provisions.
Wednesday. Spar exercise, or manœuvre ship. All hands.
Thursday. Company, or battalion drill.
Friday. Clear ship for action, general quarters, fire quarters.

WEEKLY ROUTINE OF EXERCISES. IN PORT. 1ST PERIOD.

Monday. Sail exercise, all hands.
Tuesday. Boats under oars or sails.
Wednesday. Out all boats, arm and away, or abandon ship.
Thursday. Company, or battalion drill. (On shore, if practicable.)
Friday. Aiming drill, subcaliber practice, torpedoes.

SUNSET ROUTINE. AT SEA.

Reef topsails, or shorten and make sail, or down and up light yards.
15 minutes setting up, or developing exercise.

SUNSET ROUTINE. IN PORT.

"Down light yards," once a week "down topgallant masts," once a quarter "house topmasts."
15 minutes setting up, or developing exercise.

7.30 A. M. ROUTINE. IN PORT.

Up yards, or masts, or "loose sail" (furling when convenient).

QUARTERLY ROUTINE.

Examinations. Change Stations.

SEMI-ANNUAL ROUTINE.

Target Practice, Great Guns and Small Arms.

On the ships above proposed, by reason of plenty of room, a sheltered gun deck, possession of torpedo and dynamo rooms, ordnance model room, a varied battery, modern ammunition rooms, square rigged mizzen mast, signal apparatus, etc., the routine could always be carried out except possibly during heavy gales at sea.

Special instruction in gunnery and dynamos, signals, sailmaking, carpentry, and blacksmithing should be given to apprentices showing special aptitude in each, and when they are transferred to the general service, the papers should specially indicate in what branch they are most proficient. There should be substantial annual prizes for the boy on each ship who is most proficient, or has the best conduct, and some such medal as the "Bailey" medal, for which the best boy on each ship could compete. These would be another spur to do well.

Amusements and Non-Professional Instruction.

In the case of boys, all work and no play is a bad thing, for they will lose interest. Each training ship should be provided with an organ, and one evening a week, say, during an hour in the second dog-watch, the apprentices should be allowed to sing national and distinctive songs, some one accompanying on the organ. Besides, an organ would be valuable in Sunday morning service. A few musical instruments might be provided, and any of the crew, who have the talent, allowed to form a band and given opportunity to practice and play. This is the case on board some foreign training ships, especially the German, which have good volunteer bands.

Lectures on Biblical history, naval history, ships, foreign countries, etc., might be prepared and delivered by the chaplain on Sunday evenings, as is done at the training station. Magic lanterns could be used to good effect. Boat racing should be encouraged, and games of foot-ball and base-ball allowed at times when in port.

A good library should be supplied for the use of the apprentices, and works of fiction, story, travel, as well as professional and scientific works, supplied. Books are cheap now, and cheap paper and binding are all that is necessary. In fact, it is only necessary to advertise in some large city for contributions of books, magazines, etc., and cartloads will be given.

The apprentices will be far more contented in this way, will take more interest in their duties, and will learn more. So in this connection is again seen the need of suitable training ships. It is difficult to provide anything in the way of amusement on the present vessels.

It might not be out of place to say here that special food should be provided as is now the custom, but it should be *better* than the naval ration if possible, and more adapted to boys' tastes. This will help to produce contentment, as some say the "heart is next to the stomach."

DISCIPLINE.

The apprentices must be under constant surveillance, and besides a schoolmaster for each division, should be a master-at-arms. The latter would swing on the gun deck with his division

to preserve order and correct any evil doings. Besides, these masters-at-arms would constitute the police of the ship, and could stand regular corporal of the guard watch, especially in port.

Quoting from the present regulations, "The discipline on board the training ships must be enforced with firmness and consistency. Mild means may be employed at first, to be followed by severe measures if the former fail to correct offenses." Now, the severe measures require an offense to be committed three times in many cases. Demerits may be very well to establish conduct classes, or to be included in a multiple of marks, say, but will not correct very mischievous boys, neither will the ordinary "extra duty." For the offenses of "Positive disobedience of orders," "Gross insolence and disrespect," "Lying," etc., for the first offense twenty demerits and four hours extra drill are given, and for the *third* offense in any one quarter, forty demerits and eight hours extra drill. Any boy on coming on board a training ship should know right from wrong, and for such grievous offenses as the above nothing but "bread and water" or "irons" can have any lasting effect. There is the possibility of being too mild. Summary court-martials should not be spared for aggravated offenses, and a "bad conduct discharge" should follow *incorrigibility*.

In this connection a strict discipline with the *men* should be maintained. Every bad thing on board the training ship cannot be laid at a boy's door; the men's example goes a great way.

Disposition of Apprentices on Transfer.

As far as practicable apprentices should be transferred to vessels just fitted out, or on the first part of a cruise, for reasons already given. It would also be well to have them in a special division, or divisions, on the service ship, in charge of officers who would continue the instruction until they become sufficiently acquainted with the ship on which serving, and her fittings, to be distributed to all divisions, and, when so transferred, they should be advanced in rating according to their value.

Officers for the Training Ships.

Taking the ships proposed, besides the commanding, executive and navigating officers, there should be five watch officers,

five ensigns recently graduated, one engineer officer, one surgeon, one paymaster, one chaplain, one boatswain, one gunner, one carpenter, and one sailmaker. The first eight line officers should be carefully selected from those having plenty of actual sea service according to grade, and the duty should be, as far as practicable, voluntary, as the duty is hard in many respects. The five ensigns detailed as junior officers would be on their first cruise, one being assigned to each division. By reason of their familiarity with the drills and details, they would be of considerable assistance to the division officer, and would be gaining experience on the sailing ship, standing day watches. This experience is good for all officers, and Admiral Luce says, "The fact must not be lost sight of that the practice ships, though intended primarily for the training of the naval apprentices, are, at the same time, an admirable school of practical seamanship for the young officers who go out in them."

All commissioned officers on the training ship would be in the ward-room.

Regarding this duty, I have heard it remarked that some officers at the Navy Department have said that duty on a training ship is *fancy duty*. Of course, no one who makes such a remark has ever been at sea in a training ship, and possibly not much in any. These ships spend more time at sea, during a summer cruise, than some ships of the New Navy do in three years. Special concessions should be made to those on this duty.

Permanent Crew for the Training Ship.

The rule is at present to select general service men who have the best records and send them to the training ship for the permanent crew. Unfortunately we do not always find good men amongst them, and it is difficult at times to make changes. As the boys get many impressions from them, it is not well to have men who are over-fond of cursing, swearing, using foul language, getting drunk, smuggling liquor, who are disobedient and disrespectful; but such are found even among the chief petty officers. There is no intention of running down the men of the service, but black sheep exist everywhere. Only such petty officers and men should be carried as are necessary to the thorough training and control of the boys, and to handle the

ship in an emergency, or during the time when no boys are on board. The engineers' force need only be large enough to enable the vessel to steam two days without serious inconvenience. The total number of men necessary on a ship as described would be about 110, including servants. These, with a complement of 216 boys (two training station divisions), would make a total of 326, which such a ship could easily carry. The necessity of having one schoolmaster and one master-at-arms for each division has already been referred to. There should also be a coxswain for each boat, and at least one seaman in each division (part of ship) for each watch.

Seaman Branch of the Navy.

The Navy Department has recently made some very good changes in the classification and pay of the enlisted men; and I believe that this fact, in connection with the laws allowing discharge by purchase, provision for pension, or retirement after 20 years' faithful service, permanent ratings for petty officers, have been of much benefit, and the records should show it.

In order fully to carry out the scheme of promotion by merit, beginning with the naval apprentice, and further to strengthen the training service, the writer would suggest some further changes in addition to the twelve articles under the head of "Enlisting Apprentices, Inducements," and such laws as are now in force.

Starting at the bottom of the ladder, the following classification and rules might be an improvement.

Boys enter as 3rd class apprentices, and, after six months' service on a training ship, may be rated 2nd class apprentices, if qualified. On transfer to the general service, those having a percentage of 85, and otherwise qualified, may be rated 1st class apprentices; and there will be a further promotion before attaining majority and discharge, to "Seaman Apprentice," who will have the same pay as a seaman; but such a one must be *able to perform a seaman's work*. All apprentices honorably discharged, on the expiration of minority, should be able to re-enlist within one year as "Trained Seamen," but will not have the benefits of continuous service unless they re-enlist within three months, as now required. The pay of a "Trained

Seaman" might be $3 per month greater than that of seaman. The rate of seaman gunner might be abolished, as well as special training on shore, except for warrant officers (acting).

Instead of having three classes of petty officers, it is suggested that two are sufficient, as the difference in pay between 1st and 3rd classes is too great, when the same duty is performed. The following rates should be established:—2nd and 1st class electricians, chief electricians, 2nd and 1st class gun captains.

The electricians will have charge of the dynamos and electric gear, and should be qualified to do all electrical work. Gun captains will perform the duty the name implies, and should be first-class marksmen.

No seaman should be rated as petty officer until he qualifies before a board of officers, who may be designated by the commanding officer; nor should any petty officer receive a higher rating without so qualifying. The appointments (acting and permanent) should otherwise be made as now provided by Navy regulations.

The following table shows, in convenient form, the proposed classification and pay of the *seaman branch:*

Chief Petty Officers.	Monthly Pay.
Chief Masters-at-Arms,	$70
" Boatswain's Mates,	60
" Gunner's Mates,	60
" Quartermasters,	60
" Electricians,	60
Schoolmasters,	60
Petty Officers, 2nd Class.	
Masters-at-Arms,	35
Boatswain's Mates,	35
Gunner's Mates,	35
Quartermasters,	35
Electricians,	35
Gun Captains,	35
Coxswains,*	30

Petty Officers, 1st Class.	Monthly Pay.
Masters-at-Arms,	$40
Boatswain's Mates,	40
Gunner's Mates,	40
Quartermasters,	40
Electricians,	40
Gun Captains,	40
Seamen, 1st Class.	
Trained Seamen,*	27
Seamen,*	24
Seaman Apprentice,	24
Apprentices, 1st Class,	21
Seamen, 2nd Class.	
Ordinary Seamen,	20
Apprentices, 2nd Class,	15
Seamen, 3rd Class.	
Landsmen,*	16
Apprentices, 3rd Class,	9

* Coxswains of steam launches, and barges, of commanders-in-chief, seamen in charge of hold, landsmen as lamplighters or Jacks of Dust, shall receive $5 per month additional.

Other laws now in force relating to classification and pay do not suggest any change.

Any petty officer of the seaman branch should be able to transfer from one rating to another in the same class, on passing the special examination. There should be uniformity in the

examinations, and to that end the Department might establish the requirements for each grade.

By adopting the changes as proposed in this article, or some similar scheme, it is believed that a staple class of efficient petty officers would soon be formed, men whose opinion could be sought by the commissioned officer, as it is done in the Army. This class is necessary to a sound organization, and when upheld, given privileges over and above those of seaman, and *not made one of them*, held strictly responsible in carrying out orders, etc., we will obtain the end so long desired. All the training of apprentices is to a great extent to get good petty officers as well as seamen.

Under the proposed general system, every boy, every man will have an *incentive* to go ahead; each one will be able to have ambition, and fulfil that ambition by his own exertions. There will be a reward for each good step.

Question as to Source of Supply.

In case the number of apprentices is not increased to about 3,500, it will be necessary to continue enlisting adults who have never served before, and it is often difficult to teach these enough, as they are too old to learn. Such being the case (with the exception of those enlisted for special service), it is suggested that young men from 21 to 25 years of age, of good education and character, might be enlisted, and sent on board the training ships, and given the same course of instruction for the first six months, those qualifying at the end of that time being transferred to the general service as "Trained Seamen," seamen, or ordinary seamen, according to qualifications.

Some similar system obtains in foreign countries. Of course, in France and Germany, say, where the service is compulsory, the early training of boys is not such a marked feature, and so-called volunteers, men from maritime inscriptions, and conscript landsmen are taken in training, and have a chance to develop taste and aptitude for the naval service, and profit by their industry and talent.

It is urged, however, that for seamen in our service the main dependence be placed on the apprentice system as the cheapest and best in the long run, provided some endeavors be made to foster it.

Conclusion.

The writer believes that this article is not as pointed as some might have made it, but from having spent a little time in the training service, recognizing some of its needs, and knowing that the present system does not furnish us with seamen and petty officers as we would have it, an honest endeavor is made to improve the service, if possible, and it is hoped that every one who reads this article will so take it.

America's bright naval record must never be tarnished. Our Navy must be and is, I believe, to-day the backbone of the country in her relations with foreign powers, to uphold the honor of the country and protect the interests of the private citizen.

DISCUSSION.

Rear-Admiral Stephen B. Luce, U. S. N.—This is an interesting paper, and shows a just appreciation of the great importance of the naval-apprentice system and its bearing on the question of manning the ships of our Navy with carefully trained American-born seamen. But while the author states the conditions of the problem, he fails to solve it.

In his introductory remarks the author observes that notwithstanding the number of essays on the personnel of the Navy which have appeared within the last few years, the subject of the naval apprentices "has been left pretty much where it stood." In this he is correct. He then expresses the opinion that "the present system of dealing with apprentices and their disposal after leaving the training-ships should be greatly modified or abandoned." He is right again. Further on, page 269, he says, "It must be evident that when only ten or fifteen per cent. of the naval apprentices remain in the service something is wrong in the system." Here the essayist is undoubtedly correct; there *is* something wrong. He concludes, on page 294: "It is urged that for a supply of seamen the main dependence be placed on the apprentice system as the best, 'provided some endeavors be made to foster it.'" Therein lies the gist of the whole question: provided some endeavors be made to foster it.

Why endeavors are *not* made to foster it, or why such endeavors as may be made to foster it are futile, is explained on page 580, No. 46 of Proceedings of U. S. Naval Institute, article Naval Administration. *It is our system of naval administration that is at fault.*

On page 293 the essayist declares that "No seaman should be rated as a petty officer until his qualifications have been examined into by a board of officers." But he fails to give any hint as to the means by which seamen may be enabled to qualify themselves for the higher duties of

petty officers. It is the gunnery-ship. The training of seamen for the Navy can never produce satisfactory results until we have a floating gunnery-ship. The floating gunnery-ship is, or should be, the Normal School of our training system.

By a "floating" gunnery-ship is meant a ship, not imbedded in mud nor permanently chained to the shore; and one devoted to the exclusive object of instructing seamen in practical gunnery, practical torpedo work, and cognate branches. Unfortunately the same cause which prevents the development of the apprentice system—a radically defective method of naval administration—operates against the maintenance of a gunnery-ship. This, also, is explained in No. 46, Proceedings U. S. Naval Institute, page 579, article Naval Administration.

The history of the several failures to establish a gunnery-ship on a permanent basis illustrates some of the peculiarities of our system, or rather of our want of system.

In 1858, Commander, the late Rear-Admiral, Dahlgren fitted out and commanded the sloop-of-war Plymouth as a gunnery-ship. She served the purpose well, but was soon discontinued. One bureau, or a fractional part of the Navy Department, could not keep her going.

On June 28th, 1881, the Navy Department issued General Order No. 272, for "the further development of the training system." Paragraph I. ran as follows: "Apprentices who have been discharged with a continuous-service certificate as seamen, and who shall re-enlist for five years, within three months after such discharge, may be admitted to the gunnery school for instruction in gunnery."

Par. II. "The gunnery school will be established on board such vessel or vessels, connected with the training station, as may be hereafter designated, and will be termed the gunnery-ship." Then follow certain regulations concerning the gunnery-ship and seamen gunners.

In pursuance of the policy lined out in this order the Minnesota, then stationed at Newport as one of the training squadron, was designated as the gunnery-ship. And to show the high estimate placed upon this advanced course and upon the rating of seaman-gunner, which was to be the reward of success in passing the examinations on the termination of the course, the rating (seaman-gunner) was placed at the head of the list of seamen petty officers, with the pay, for those who had served for two years as such on board a sea-going vessel, of $33.50 per month, at that time a comparatively high pay.* This was one of the "inducements" held out to the apprentices. It was the stepping-stone to the grade of warrant officer.

The Minnesota was no sooner organized as a gunnery-ship than she was sent to New York, tied up to a wharf, and converted into a receiving-ship for naval apprentices. Seamen were thereafter to be trained on shore, in everything and anything but gunnery, and the pay of seaman-gunner was cut down to $26.00 per month.† This was failure number two.

* See Navy Register, January 1, 1883, page 5.

† In the discussion on NAVAL TRAINING, page 409, No. 54, U. S. N. I., Boatswain Sweeney, U. S. N., in answer to the question, "How are seamen-gunners to be induced to remain in the

In his annual report of 1889, the Secretary of the Navy stated that the Lancaster had been recently surveyed, and ordered to be repaired for use as a gunnery-ship. He recommended that the number of apprentices be increased from 750 to 1500, and continued: "At the same time, the course in the training-ships should be extended by the formation of a special class for training in gunnery on board a ship devoted exclusively to this purpose. The incalculable importance of giving to enlisted men this training, especially in view of the change in naval armaments that is now in progress, has induced me to set apart the Lancaster as a gunnery-ship; and I strongly urge that authority be given to procure for her at once a modern battery."

In response to this wise recommendation, Congress made a liberal appropriation, some $200,000, and as soon as the ship was ready for the duty for which she was designed and fitted out, she was forthwith sent to the East Indies! This was failure number three.

On her return from that cruise she was again fitted up for a gunnery-ship.

In his report of Nov. 27, 1895, the Secretary of the Navy wrote that "the Alliance and Essex, training-ships for naval apprentices, had made their usual cruises," and that "the Lancaster had been assigned to similar duty." The Chief of the Bureau of Ordnance reported (1895) that the Lancaster had been fitted with a modern battery; and, further, that "if the exigencies of the service will permit the Lancaster to be used as a gunnery training-ship (the purpose for which she is intended), much good will accrue to the service." But the "exigencies of the service" did not permit, and as soon as she was ready to enter upon her duties as a gunnery-ship she was straightway sent to the Brazils! Such was the fourth failure!

The history of our naval-apprentice system furnishes similar illustrations of some of our peculiar methods. Established in 1875, it is to-day, in the matter of supplying seamen for the Navy, "pretty much where it stood," to quote the essayist once more. The following remarks, written by the Secretary of the Navy seven years ago, point out one of the evils and suggest the remedy:

To meet the want of trained American seamen, the naval-apprentice system was established. The Department, at great labor and considerable expense, has steadily improved this system, until at the present time it turns out apprentices of excellent quality. From all this, however, the Navy derives little benefit. All terms of enlistment of apprentices now expire at twenty-one years of age. When they reach this point the majority of them leave the service forever. They have received an education at great expense to the Government, and yet have been too short a time in the service to have formed an enduring attachment to

service?" answers that it is merely a question of pay, which he illustrates as follows: "Of six seamen-gunners of the same class sent to a ship, *one will, in all probability, be rated electrical machinist at $70 per month; one an armorer, at $45; and the four others may get the rates of oilers or water-tenders at $36 and $38 respectively*." We learn from this the significant fact that the effect of training seamen on shore is to convert them into *machinists*. "Seaman-Gunner" is therefore a misnomer. The title should be *Seamen-Machinists*; or, simply *Machinists*.

it. They carry off with their discharge the benefits of the Government's outlay, and apply them to the pursuit of other careers. *The Government educates them as boys to lose their services as men, and the result is that while we have provided an elaborate system of training, we are forced to depend for seamen on an untrained service largely composed of foreigners.*

The plain remedy lies in a statutory extension of the term of enlistment to twenty-four years of age. During the additional three years, the formation of associations and a mature judgment will lessen the inclination for change, and the Government will get the services of those whom it has trained, for at least one full cruise. In the English Navy, the adoption of a rule retaining those who enlist as boys until the age of twenty-eight or thirty has completely changed the character of the enlisted force.

Here we find the Secretary of the Navy himself taking part in the discussion of this very important question; but nothing was done to correct the well-recognized evils. The naval-apprentice system is still "left pretty much where it stood." Short-term service, small pay, and misdirected (not "an elaborate system") training, due to a certain aversion for ship-life, go on just the same, and result in the very small percentage of apprentices who re-enlist after attaining their majority.

The essayist very properly condemns the practice-ships Alliance and Essex, and declares that they are enough to disgust the boys with the service. "It is difficult," he says, page 278, "to turn out good material"—apprentice boys—"under present circumstances." He then, somewhat illogically, extols the barracks plan. "The great feature of first having the boys on shore," he says, "is that they have clean barracks, plenty of room, fresh air, fresh water to wash with, and that they are *constantly* under surveillance." Would not the pleasant life, under such circumstances, supplemented by field sports and the rest of it, result inevitably in intensifying the "disgust" of the apprentice for the "poorly lighted and ventilated" accommodations of the training-ships. "where hammocks hang on hooks like sardines in a box"? There can be no question on that point. It would. The true and only way to begin the "breaking-in" process of the naval apprentice is to put him on board a stationary school-ship at once. With a properly fitted-up school-ship there would still be the "great features" of *a clean ship—plenty* of room, fresh air, fresh water to wash with, and the boys be under "*constant* surveillance," with these additional advantages that the apprentice would be initiated at the very outset into the mysteries of his new life, and be all the better prepared for the discomforts of the cruising training-ship.

On board the stationary school-ship the apprentice makes a fair start; in barracks he makes a false start. On board the school-ship the first and most lasting impressions are connected with life on the water and association with the better class of seamen; in barracks the first impressions are connected inseparably with the attractive features of life on shore and with soldiering. In short, the one method makes sailors; the other makes anything but sailors. It is this constant hankering for the shore that is one of the crying evils of the U. S. Navy to-day.

When barracks for naval apprentices were first proposed it was gen-

erally understood that the apprentices were to be quartered on shore in "light, well-ventilated" rooms for the first six months after enlistment. During that time, by some occult method, not fully explained, the bad habits, if such there were, of 16 years, the average age of the apprentice, were to be so thoroughly eradicated that the advantages of the barracks might thereafter be dispensed with. The boys could then be sent to sea with their morals sufficiently safeguarded. But if six months of barrack-life can produce such a wonderful effect, certainly an extension of time would be desirable. Hence we find the essayist saying, page 276, "The apprentices should remain at the station not less than six months, *and if possible, from nine to twelve months* . . . for the purpose of developing the mind and body at the start." Here we see plainly the marked partiality for the shore—the disposition to extend the time on shore, and the specious reasoning in support of it.

The light and airy quarters of the barracks, the gymnastic exercises, the infantry and artillery drills, with "less seamanship and gunnery," as the essayist recommends, would undoubtedly develop the physical powers of the apprentices; there is no question about that. But at the end of the year they would go on board the training-ship, not with "disgust," but with positive loathing. Now there is nothing that can be done for the apprentice in barracks that cannot be done much better on board a properly fitted-up school-ship. There are no better gymnastic exercises than running up and down the rigging of a ship, pulling and hauling on ropes, rowing in boats, etc. Running along with this course of physical training is the ceaseless process, by day and by night, sleeping or awake, of the process of mental absorption, by which the apprentice is taking in, or "hoisting on board," some of the most valuable lessons of the calling of his adoption. His mind is in its plastic state, and he is surrounded by formative influences which mould his character as a seaman. All other considerations are secondary. This species of training cannot begin too early. It furnishes the staying quality by means of which the young seaman is retained in the service when other influences fail. It is the very foundation of his training as a seaman. This invaluable part of the training of the naval apprentice is not only lost while in barracks, but what is much worse, his mode of life there, his habits, thoughts, associations are all diverted into another channel, and one running in a direction diametrically opposite to that into which it is the object of naval training to lead him. And all for what purpose? That he may be under "constant surveillance"! As if that quality inhered to barracks alone, and was foreign to ship life. I make no reference to morals, for the simple reason that the morals of the apprentices can be as well safeguarded on board the school-ship as in barracks, perhaps better. It rests solely with the officers, not on the habitation.

To say that American naval officers cannot conduct the training of naval apprentices on board ship during the first six months of their career, and exercise "constant surveillance" over them, is to confess that, in this respect, they are inferior to the officers of the English and the French navies. I, for one, am not willing to make any such admis-

sion. And yet the radical difference between the methods of educating officers in our service and in foreign services goes far to account for certain other differences. English and French naval officers receive their education on board ship; ours in barracks on shore: they are content to live on board ship; we, as a general rule, are not. In foreign navies there is a premium on sea-service, which includes, in part, duty on board ships on harbor service; with us the fruit falls to those who can stay on shore the longest. A disinclination for sea-service is instilled in our young officers from the very outset of their career; it is made a part of their education. The reverse of this obtains in both the English and the French navy. As a natural consequence, all their training for seamen, boys and others, is conducted afloat. The Navy with them is too serious a matter for trifling. With us everything is done on shore that it is possible to do on shore.

In the last published report of the Board of Visitors to the Naval Academy (June 7th, 1895) it is recommended that the present six years' course be reduced to five years, *all of which shall be spent at the Academy.* In other words, it is recommended to have five years in barracks, to wean the cadets still more from their legitimate profession as sea officers. The present plan has given the Navy two distinct classes of officers, which may be roughly divided into the sea-going and the non-sea-going. There are those who have an innate love for their profession. No amount of barrack-life can alienate them from the sea. There are others again who, having no natural aptitude for the naval profession, gladly lend themselves to the system which cultivates a taste for the shore. The proposition of the Board of Visitors is to cultivate this taste to a still higher degree, and to eradicate, as far as possible, the characteristics of the sea officer.

The law requiring the academic course of naval cadets to be six years is undoubtedly a wise one. Unfortunately the additional two years were put at the wrong end. The two years of sea-service should have preceded the academic course, instead of being made to follow it. By devoting the two first years of the cadets' naval life to the practical parts of their profession afloat, followed by three years of theoretical and scientific studies at the Academy, far better results would undoubtedly be secured. Such a plan, while it would weed out, at the beginning, those who had no aptitude for the naval profession, would conform to the fundamental principle of the science of education, that *the practical should precede the theoretical.* It would, moreover, react favorably on the naval training system, and bring a larger proportion of our officers in sympathy with the seaman class of the *personnel.* But notwithstanding the disadvantages attending the practice of educating naval officers on shore, there are numbers of them who are thoroughly devoted to their profession, always ready to go to sea and perfectly willing to live on board ship when their duties call them there. With such officers the training of naval apprentices can be carried on far better on board ship than it possibly can on shore, and with far better results.

I cannot agree with the essayist in his views in regard to a practice-ship. *A practice-ship should have no steam.*

The Board of Visitors, whose report has just been quoted from, says, "It is essential that every line officer of the Navy should be an accomplished seaman." Hence, as part of the equipment of the Naval Academy, "two lightly sparred, fast sailing sloops-of-war, which should be full-rigged ships," are recommended. The Superintendent of the Naval Academy makes a similar recommendation. He asks for "sailing vessels with no steam on board," and in his letter of January 22nd, 1896, he urges his plea in such a clear and forcible manner that I cannot do better than commend it to the consideration of the essayist. "Seamanship," he justly observes, "cannot be taught on board of steam practice vessels or unwieldy converted steamers." He is right. If a sailing-ship is essential for the proper training of young sea officers, how much more essential is it for the proper training of young seamen?

A word as to training-ships. The naval apprentice should begin his career on board a properly fitted-up school-ship, the ship being for harbor service only. We have never had such a school-ship. The old line-of-battle ship New Hampshire was the nearest approach to one; but she was wanting in proper sanitary and other arrangements, which the Government would not furnish. The law which prohibits repairs on wooden ships when the estimated cost exceeds ten per cent. of the cost of a new ship, operated to prevent the expenditure of money on the New Hampshire. The Bureau of Construction having no interest in the apprentice system, begrudged every penny spent upon her. That Bureau would not even furnish her with boat-davits, so that she had no means of hoisting her own boats; hauling the ship in and mooring her to a wharf was, in a great measure, a necessity. Here she formed a cesspool for herself, sickness broke out, a board was ordered to examine *and condemn her*, and the ship was sent to New London; the boys, in the meanwhile, having been sent on shore, where they lived in tents. That was in 1889. The apprentices at the station have been on shore ever since. There was no effort made to fumigate the ship or put her in proper sanitary condition. At a moderate expense she could have been made an ideal school-ship, but all appeals were in vain; the Government was determined to get rid of her, and she is now doing duty as the drill-ship of the New York Naval Reserves.*

From the school-ship the boys should be sent to the cruising practice-ship. This, as already stated, should be a sailing ship. The Portsmouth, Saratoga, and Jamestown were model practice-ships. Neither the English nor the French navy could produce their equals, but they too have been given away. The Constitution made an excellent practice-ship, and was so employed for a time; but she was given up. It has been the policy to get rid of all the vessels that could be made useful for training purposes. The Government has given away, or otherwise disposed of, about 12 ships of various classes, some of which would have been invaluable to the training service. The last ship to be disposed of is the Pensacola. At a moderate expense she could have been converted

* It was commonly reported that the New Hampshire was too unhealthy for the naval apprentices. Just how unhealthy the ship is may be seen by the double-page illustration in *Yachting*, Vol. II, No. 21, May, 1896.

into an admirable school-ship for the training station just established at San Francisco.*

From this brief sketch the essayist will see that the newly recruited apprentice boys were put on shore at Coaster's Harbor Island, not from choice, but because the school-ship was taken away from them and they *had* to go on shore; *secondly*, that no school-ship has ever been properly fitted up for their accommodation; and, *thirdly*, that the very perfection of training-ships, the Saratoga, Portsmouth, and Jamestown, were given away.

The Alliance and Essex are no doubt very poor apologies for training-ships, but he should be thankful they are no worse.

Lieutenant W. Winder, U. S. N.—To be in thorough accord with Mr. Tisdale one must be a believer in the apprentice system. This, I candidly confess, I am not. Since, however, there seems every likelihood that an apprentice system in some form will persist, anything tending to increase its efficiency should be welcomed, and it seems to me that the essayist has offered some valuable suggestions touching this matter.

In particular I am impressed by what is said concerning new and properly designed vessels for training purposes. The necessity of such vessels must be obvious. The discomforts incident to the present training-ships, many of which, as Mr. Tisdale points out, may be remedied by modern construction and appliances, are manifestly not calculated to inspire much love for the service. And this is especially true with regard to boys, some of whom have recently left good homes, and all of whom have been made reasonably comfortable at Newport during a considerable period preceding their first experience of shipboard.

It is not to be expected that any vessel can have "all the comforts of home," but as the comfort of existence advances on shore, improvements at sea, while perhaps not keeping abreast, must at least keep within hailing distance if we are to retain the services of such men and boys as we desire in the Navy.

I entirely agree with the writer when he says, "The training squadron is no place for incorrigible boys, of whom parents or guardians wish to rid themselves"; and again, in the same paragraph, "Then there is a great deal too much of this business of stepfathers and stepmothers forcing their boys to enlist in the Navy." As a recruiting officer I have had some experience in this matter; but unhappily there seems no certain way of preventing this evil, as the boys invariably state, as required by regulation, that their enlistment is voluntary.

The force of the writer's remarks concerning the modern seaman, and the points in which he should differ from the old-time sailor, must, I should think, be apparent to every one. In these times we have no use for men who are "very dependent" and require "always to be looked after." This class has remained with us too long. It is dying out, but it still leavens the mass of the personnel to an embarrassing degree.

On page 281, under the head of Batteries, it is remarked that "The idea

*Since the above was written it has been currently reported that the Pensacola is to be fitted up as a school-ship for San Francisco Bay. It is to be hoped this report is true.

is to have a battery as diversified as possible to give room for instruction. The latest type of modern small arms should also be provided for instruction, though for drill, older types might be used for economy."

To any one who has endeavored to instruct recruits on a receiving-ship having at his disposal an obsolete battery, or (as in the case of the Wabash) no battery at all, and small arms which would bring a smile of derision to the face of a Chinaman, this suggestion will call up emotions which might properly pertain to a dream of the millennium. I earnestly hope that should the essayist's views ever materialize, this point will not be overlooked.

Having during my entire service noted the increased pleasure and contentment which a band offers to the men on board ship, I most heartily concur with Mr. Tisdale's remarks on this subject (see page 289, "Amusements and Non-Professional Instruction"). This is a matter which is by some looked upon as worthy of little consideration, and in view of the more serious matters which engross the attention of officers, it may appear frivolous; yet I believe this to be an error. I have always been impressed with the advice given in a standard work on seamanship, to the executive officer, in which, among other things, he is urged to obtain the services of "a good fiddler." I have too often seen the pleasure which, during leisure hours, the crew received from music, to feel that the question is to be treated with contempt.

Bands will, I presume, continue to be attached to flagships. At present they are, as every one knows, composed of men most of whom it would be irony to style combatants. It therefore happens that the band has many enemies, especially among the first lieutenants, who feel that it takes the place of more useful men. By encouraging, without unduly interfering with their more important duties, a musical training among such apprentices as show aptitude, a class of naval musicians might be established who could on occasion take their places at the guns, or in the company, side by side with the best in the ship.

I am forced to dissent from the writer in several particulars. In the second paragraph, on page 266, he refers to the fact that after leaving the training-ship the apprentices receive too little special instruction and care. I think he falls into the error, which appears to be somewhat prevalent, of confounding a cruising-ship with a school-ship.

In my opinion, the ideal cruising-ship should be the *finished ship* in all respects. As our ancestors put it, she should be ready "to encounter an enemy or weather a lee shore." Drill and exercise will always be essential, no matter how excellent the organization or efficient the personnel. But as a millionaire once said to me, "I have to work, not to make more, but to keep what I have got." And I think this idea should apply to the internal exercises of a cruising ship-of-war. Many officers seem to look upon drill as *an end*, instead of a *means to an end*. I believe that business principles demand from the officers of cruising vessels about all the attention they can give to the *current* working of the system of which they form part. And I look upon it as a useless hardship for them to be required to devote extra work to a class which

is of little present value. and which will. as Mr. Tisdale shows, almost entirely dissipate instead of rendering useful future service. Let officers rather give this time to their divisions as a whole, so that as far as possible their ship may be ready in all respects *to-day*.

If this be done faithfully, *to-morrow* will surely take care of itself.

I must disagree with Mr. Tisdale when he says "There is too much of that wide gulf existing between the enlisted men and the officers," and I fail to see how he reconciles this view with that expressed on page 286, viz., "An officer must not have too much contact with the enlisted men, a little aloofness is better." It is true that these statements do not contradict each other directly in terms, but it seems to me they do so in spirit. That a mutual sympathy and respect should exist between the men and their officers I presume no one will deny. But the experience of ages has established a gulf between them, and this seems to be required by the necessities of discipline.

I must differ from the writer's views concerning promotion from the ranks. A system contemplating such promotion is, in my opinion, less dangerous under monarchical institutions than under democratic institutions, on the general principle that the less secure the position the more tenacious must be the prerogative.

Socialism, now rampant on shore, will, it is to be feared, sooner or later affect military organizations. Indeed there are not wanting indications that the infection has already begun.* Should socialistic ideas unhappily obtain a firm foothold in the naval service, a state of affairs must ensue compared with which a pestilence would be a positive benediction. We cannot, therefore, be too wary lest in adopting seemingly innocent and benign doctrines of democratic civil life, we receive the thin edge of a wedge which ultimately may work incalculable damage to naval discipline.

There are to-day, and doubtless always will be, many persons in the enlisted force of the Navy entirely worthy of bearing commissions. But I hold that to reward individual merit in this manner, however just its claims, would be inadvisable as, by fostering democratic notions in an organization whose internal relations can never be democratic and live, it would seem to threaten those barriers which from time immemorial have been deemed indispensable to military government.

Finally, I wish to express my appreciation of the sentiment conveyed in the concluding paragraph of the essay. In this I am sure I will be joined by all readers of Mr. Tisdale's interesting paper.

Lieutenant A. F. FECHTELER, U. S. N.—I heartily endorse the general scheme of training apprentices as set forth in Mr. Tisdale's essay. Also his ideas regarding inducements to remain in the service.

In one place "irons" are mentioned as a mode of punishment. Of course the boys should not be "coddled," but when one of them needs irons, it should be followed by his prompt discharge.

* Since writing the above, events have occurred in the Navy which singularly corroborate this view.—W. W.

I do not believe in having junior officers on the training-ship. It will soon be impracticable to spare so many line officers for that purpose, but apart from this, it is not desirable.

The instruction and drilling of the boys should be chiefly in the hands of warrant and petty officers—picked men. By all means give the apprentice a chance for a commission, as suggested in the essay. These commissions, however, will necessarily be very few, while warrants and appointments will be many. Show the apprentice at the very beginning what is within comparatively easy reach by putting him in touch with the finest graduates of the apprentice system to be found in the service.

This matter of the *personnel* of the training stations and ships has not been sufficiently emphasized in the essay. It seems to me all-important.

No matter what material advantages in the shape of food, clothing and pay are in sight, boys will not remain in the service and become such men as we want, unless they love and respect it.

I have served on board a training-ship, with the boatswain's mate of one gangway a good seaman, but confirmed drunkard; and the mate of the other gangway sober, but no seaman. Comment upon such a state of affairs is of course unnecessary.

Every person, whether officer or enlisted man, connected with the training of naval apprentices should be selected on account of his fitness for that particular duty. I firmly believe that more good boys are lost to the service by falling into the wrong hands at the start than for any other reason.

The essayist well says, "If there is no ambition in a man, what can we expect of him?" Whatever spirit, ambition, or love of the service the naval apprentice may have, must be obtained from his first instructions. Rules and regulations are very well in their way, but it is their enforcement that counts.

We can afford to have one, or even several, men-of-war lacking in efficiency; but to have an efficient apprentice system it is absolutely necessary to have the training-stations and training-ships models in every respect.

Officers on the Pacific Station feel most keenly the necessity for good petty officers, and hence their interest in the success of the apprentice system.

Lieutenant W. B. FLETCHER, U. S. N.—Ensign Tisdale's article is excellent and thorough.

In the training-ships proposed, why have steam, electricity or torpedoes?

Quoting from page 281: "Admiral Luce says referring to the sailing ship. . . . Indeed it is well known that such an experience (in sailing ships) does affect character and has endowed the sailor with those high qualities of self-reliance, endurance, courage, and patience under difficulties, which have always characterized him." Therefore, why attempt more in the training-ship than the production of the "sailor," leaving torpedoes and electricity for the cruising vessel? Keep the apprentice ten months in the training-ship, as suggested—the time at present is too

short—and aim at thoroughness in what is undertaken, without undue haste; quality rather than quantity; skill with the marlinspike; plenty of time to overhaul clothing; and habits of neatness thoroughly inculcated. In lieu of something better, why not take the engines and boilers out of the Essex and Alliance, save an auxiliary boiler? Give them a flush spar deck and ship rig, and with a flush berth-deck they would then each accommodate one hundred more apprentices with comfort.

The division officers need assistants to help with the instruction. I hardly think it so necessary that each officer take one branch of the instruction. Longer periods of instruction as proposed are needed, and would result from keeping the apprentices on board longer.

Instead of making one long and one short cruise, I would suggest two cruises a year of equal length; one half of the apprentices to be transferred at the end of each cruise; the other half being available to fit the ship out, and being familiar with ship-life, would lead the green ones into their places. At present, on taking 108 green apprentices on board, a month is necessary for them to find out where they are.

Lieutenant W. L. Rodgers, U. S. N.—The paper is so clear a presentation of the present condition and needs of the training service that it is difficult to suggest any additions or to offer any radical criticism of its proposals.

I think, however, that instruction in electricity and torpedoes is too ambitious a programme, and would be content with the present curriculum extended over a year's course. The boys are too much crammed now, and any addition to their studies would be unfortunate even with more time.

The necessity for larger vessels having a covered deck and for reverting to the employment of schoolmasters cannot be too strongly urged, for drills must be carried on in bad weather, and an officer alone cannot give proper attention to the individual instruction of his division of 25 restless boys.

The men who are sent to the training-ships are frequently of an undesirable type in other ways than those mentioned by the paper. For a sober, respectable petty officer without force of character to make the boys respect and obey him is nearly as bad as one who sets a bad example.

Commander F. W. Dickins, U. S. N. The Board of Control:—I have read Ensign R. D. Tisdale's essay on Naval Apprentices with much interest, and thank you very much for the implied compliment in asking me to criticise his article, which I do not feel that I could do to my full satisfaction without possibly making myself amenable to Article 235, a regulation I have no intention of violating.

I cannot agree with the essayist that the present system of dealing with apprentices should be greatly modified or abandoned. In my opinion, any system, or one that has the approval of an officer of experience, applied to the training of apprentices, either at the Training Station or afloat, if faithfully carried out, avoiding all excuses not to have drills,

but rather to make excuses to have them, will produce good results. Of course, there will be some details in any system which from actual experience suggest some modifications, and, I think, if the writer of the essay would now visit the Training Station and carefully note what is being done here, he would find that some of his ideas and "should-be-dones" are now in full operation.

The system as now organized is persistently and faithfully carried out. It works smoothly and well. The boys are well behaved, discipline well preserved, and desertions practically nil. The results do not warrant the writer's suggestion to "abandon" anything. During the past two years of my command here, quite a large number of our modern men-of-war have been in port, and I have taken the pains to enquire of the commanding officers of the vessels what men occupied the most important petty officers' billets on board, and the answer has invariably been, ex-apprentices. What can be better than that?

I think I agree with the writer that the age of entering should be older, say from 15 to 17 years inclusive. A boy 14 years of age is apt to be very small. A year older would greatly improve his physique and give him more strength to do the work necessary to commence to learn his profession.

The object the Government has in view in enlisting boys to serve as apprentices is to obtain trained seamen to man our war vessels. The Training Station and ships are maintained for that purpose. They are in no sense a training-school to provide admirals nor presidents, commanders-in-chief of the Army and Navy. We have a school for training officers, and the conditions for entering are as democratic as it is possible for a republic to be. The scientific and professional requirements of the up-to-date naval officer are too great to be acquired in a school devoted to training boys for the "man behind the gun," and he should be encouraged to feel that a competent sailor is a valuable man and that he has an honorable profession. His pay, on an average, is superior to his class in civil life. Those of us educated at Annapolis might aspire to be United States Senators, but we were impressed while there with the idea that the career of a naval officer was an honorable one and sufficient for us. So apprentices should be encouraged to know that a chief boatswain's mate or a warranted gunner is a man favored far beyond the average of his class.

The two most important men in time of battle are the one who commands the ship and the one who points the gun, and each should be trained only for the duties required of him at the supreme moment.

Much use is made here, when the weather is favorable, of the training-ship Constellation in handling sails, spars, etc., as the drill is considered a very resourceful one for a boy destined to become a sailor. It draws on his intelligence, nerve, alertness and confidence. This drill, in connection with a recommendation I made while in command of the training-ship Essex:—"That infantry, artillery, pistols, broadswords and gymnastics be omitted in the routine at sea, as they may be better taught in port, and the time given to sails, spars, marlinspike seamanship, lead, log and

compass. In fact, the boys were found to be so well drilled at the Training Station in infantry, broadswords, signals and gymnastics that much of the time now given to those drills on board could be well employed in other instruction," together with my statement: "Training apprentices is very interesting work, and it particularly entails a large amount of work on the executive and watch officers, and of course they should be in full sympathy with their duties. I think they need to be encouraged as much as possible, and, while I think it is their simple duty, I think it would add to the popularity of the training-ship if after finishing a cruise with one lot of boys, the ship remain in port long enough to give each officer a short run, if he desires, before starting off again. I am also of the opinion that long stays at sea in these days of rapid events has, on some officers, a depressing effect; and, I think, there would be more buoyancy in the feelings of all hands if the ship made a port at intervals of not more than fifteen days. These are simply my impressions formed from an experience of one year in command of training-ships, also as watch officer and as an executive officer on board a training-ship,"—do, I think, conform to the pith of the ideas of the essayist. The impression that seems to more or less prevail, that apprentices receive this training in barracks, should be, as far as possible, dispelled, for it is erroneous and wrong.

A boy who enlists at 14 years of age has 7 years to serve. Six months of that time he is here being taught the rudiments of his profession to get him in a proper condition to go on board a training-ship, where he remains another six months, after which he goes into general service to serve the balance of his enlistment. Six months' training on shore out of seven years cannot be called training in barracks.

One year connected with the Training Station, a six months cruise at sea on board a training-ship, being an integral part of it at the proper time and place, is, I think, sufficient training to put a boy into general service, where the fact that the boy is still an apprentice, and will remain one until he is 21 years of age, and that his instruction should continue under less irksome conditions, should not be lost sight of.

I am of the opinion that the rating and pay of instructors should be that of a chief boatswain's mate.

Commander J. F. Merry, U. S. N.—The essay presented by Mr. Tisdale sets forth in a very practical manner many important facts that should be carefully considered, and I thank him for placing in such a broad light many needs of our training service. If we are to expect any better results from our apprentice system, we must make some changes; but where to begin is the question. One would naturally suppose at the beginning, at the enlistment, and ask, is our present system of recruiting the correct one? Instead of drawing a very large percent of our apprentices from New York City, should we not make an effort to secure men to man our Navy from the sea-coast all along our coast, from Maine to Savannah. Settle on the age best adapted. I would suggest from 15 years old up, and make the term of service five years, no matter what

age at enlistment, say from 15 to 20 years. As a rule our apprentices are too young, and I will venture to suggest that a large percentage of our apprentices leave the service from different causes before they have been one year enlisted. Heretofore young men from 18 to 21 years old could not be enlisted because it has been held that a parent could not bind his son to serve after he is 21 years old, and that a minor cannot bind himself to serve at all; but I believe a recent decision has been made by the Attorney-General that this can be done.

Now that the age is settled, we must have some new training-vessels. I should say that the Alliance class is about the best tonnage. Large vessels are not as well adapted as smaller ones. The yards are too heavy, foot-ropes too long, sails too heavy; then a divided force can better cruise along our coast and recruit the young men who desire to enter; visit all our sea-coast ports once a year; land the battalion, show the people the ships, and explain the advantage of service of the Government. These recruits could be divided, and those over 18 called landsmen, with more pay than their juniors. All should be advanced and detailed to sea-going ships when they develop proficiency. I do not believe in keeping a smart youngster a seaman if he is capable of being a petty officer and no better material at hand. Promote him, encourage him, not let him drag along and see poorer men of less ability advanced just because he is not 21. As soon as enlisted, all should be assigned to some *ship*, and *not* be kept in barracks. It takes some time for a landsman to learn how to live on board ship, and this education should be commenced at once. Some legislation should be adopted whereby a commission could be secured for the enlisted man, but I doubt if it would be best to have him acquire a warrant first. Decide annually upon who is to receive a commission, and then give him the advantage of an advanced course at the Naval Academy or on board a sea-going ship, but make it possible for any man enlisting as an apprentice or seaman to secure a commission, and the standard of our naval seaman will be raised at once.

Recruiting men for the Navy is the most important duty that an officer can be assigned to, care should be taken in selecting such officers, and it should be followed up certainly to the commanding officers of our training-station and training-ships. I think it would add to the efficiency of the enlisted men if some suitable officer was given entire charge of this duty. A Bureau officer has so many duties to attend to, that it would be better to have this duty done by an officer with no other duty. Make his headquarters where you will, not necessarily at Washington. Make it at Newport, but give him entire control of this branch of the service.

I believe with the essayist that the ships with all their equipments and battery should be of modern type; we have had enough of obsolete vessels. A vessel of 700 tons register can be contracted for, for $50 per ton, hull and spars, and at the present time she could be completely fitted for sea for $50,000, outside of her battery. Our old ships soon use up this amount on repairs.

I agree with Ensign Tisdale on the subject of pay. As soon as a man

is enlisted and his pay commences he will look for a larger salary, and the pay should be so graded that every man could receive higher wages every three years, or perhaps for a shorter period of service, whether he is promoted or not. Longevity pay should be adopted, and a service pension should go with it after a certain number of years' service. Men would look forward then for a length of service and feel proud of their service badges. Honorable discharge money should be due the man if he enlist within five years. Often a man secures employment after discharge, and in course of time employment ceases, he has found work on shore a failure, his discharge limit has run out, and he loses the benefit of his past service. Extend the time and many men would re-enter the service that do not.

Ensign Tisdale deserves the thanks of the Institute for his able paper, and I hope it will be read widely, both out and in the service.

Commander C. F. Goodrich, U. S. N.—There is among naval officers, as there is indeed among the American people at large, a growing disposition to seek in legislation the remedy for their woes. I think we should all combat this tendency and strive to realize that we have no right to apply to Congress for relief until we have exhausted all the means open to us through existing laws. The powers lodged in the hands of the Secretary of the Navy are vast and are only limited by the statutes. For the wise exercise of these powers he must trust to the counsels of his subordinates and advisers, to that general professional public opinion which reaches his ears in a thousand ways, and to such specific recommendations as are evolved through the papers and discussions of the Naval Institute. The latter appear to me an especially valuable instrument for bringing out the views of the service and the arguments of opposing schools of thought on the various subjects which always interest and sometimes vex us. For this reason it seems to be a duty incumbent on officers to express their ideas on such topics in order that, elimination made of minor differences, the substantial voice of the Navy may be heard.

We have devoted some dozen or more years to the development of our material, and have given to the task our best, I had almost said our undivided, energies. Logically this was unavoidable; our crying need was for ships, in the modern sense. Now that we have the ships, the question how best to man them presses upon us and demands answer. The essay of Ensign Tisdale is an attempt to provide that answer by an officer who evidently has the matter keenly at heart and who enjoys the great advantage of a lengthy experience on board a cruising training-ship. He is thus able to speak on many points from personal knowledge. With his views I am, in general, in complete agreement.

Whether or not it would be prudent to hold out a prospective commission as an inducement to enlistment by the would-be apprentice requires serious consideration. Doubtless under the present regime we lose an occasional Nelson, just as we may lose him among the members of the graduating class who fail to win in the competitive final gradua-

tion; but risks must be run, even in time of war, and this is one we can accept with a certain degree of complacency, since Nelsons are not birth-marked and are therefore unrecognizable in time of peace. There being a superabundance of talent produced at Annapolis, I think the burden of proof should rest with him who advocates diminishing the number of vacancies in the service open to the graduates of the Academy.

The warrant of a gunner or boatswain offers, in my judgment, abundant inducement for the very class of men we desire. We want, by the way, to recruit the forecastle and not the admiral's stern gallery. The warrant carries with it responsibility and power, as well as a rank understood and recognized the world over, not to mention a salary which, taken in connection with the social standing and needs of the owner, makes him incomparably the best paid man in the Navy. There is scarcely a lieutenant, for example, who has not to meet great, perfectly proper and matter-of-course service demands upon his purse, from which the warrant officer, with but little less income, is entirely exempt. Where the warrant officer is able to save up and invest, the lieutenant thinks himself lucky if his two ends meet. Figuratively speaking, the one lives in affluence, the other in genteel poverty. The former enjoys a degree of financial success which is beyond the reach of the average citizen. As a substantial reward and inducement, the warrant leaves little to be desired. It only lies with us, his superiors, to utilize the warrant officer on board ship, to make the most of his virtues and training, and to foster a legitimate pride in his calling, to remove the last sound pretext for discontent. To open to this class of officers a possible road to a commission would introduce a baleful and never-ending source of dissatisfaction among them and among the apprentices from whom they are recruited, would hold out a delusive hope to their ambition, and would embitter the nine unsuccessful aspirants while rejoicing but the one more fortunate. The apprentice system was wrecked once before by rendering certain of its graduates eligible to the Naval Academy. I can see no reason for supposing that a different result would attend the granting of commissions to warrant officers, no matter how the process might be guarded or administered. The proposition is fraught with grave consequences. Full and free discussion can alone establish its claims to our acceptance.

I have only touched upon the one point where I differ *toto cœlo* from the essayist. In other essentials I am, in the main, in entire accord with him, especially approving the suggested regulations for the enlistment of apprentices, except those relating to the commission.

It is a pity that the training system is not everywhere appreciated as a branch of the service second in importance to no other. It takes the American boy and makes of him an American man-of-warsman. It stamps him forever with its own merits and demerits, and it influences his life till its close. It is a school of patriotism and duty. Surely it deserves just such careful, sympathetic study and such able representation as are shown by Mr. Tisdale in his excellent essay.

Lieutenant C. H. HARLOW, U. S. N.—The advance copy for discussion of Ensign Tisdale's essay on "Naval Apprentices, Inducement, Enlisting, and Training," etc., only reached me on the evening of June 23rd, and as it calls for replies to be in by June 25th, there is too little time to thoroughly enter into a discussion of it, especially in the matter of statistics. A few of these that I have compared with the reports of the Bureau of Navigation are quite at variance with these carefully prepared records as to "acceptances and rejections of candidates," "desertions," and "those that remain permanently in the service." They are so much at variance as to make me sceptical as to the correctness of the other statements, and lead me to believe that if I had the time I might question nearly all the statistical statements that the essayist makes. It is too bad that this should be so. An essay on professional subjects should have been thoroughly tested in details of that kind, particularly as the Department is always ready to furnish any officer who applies for it, all the absolutely correct information on this subject that he may want. I know that figures are notoriously deceptive, and reasonable allowance should perhaps be made, but any statements which differ from those verified by the Department records so materially as those of the essayist cannot pass unchallenged. I feel that no discussion would be complete or sincere unless some attention were paid to this phase of the question, and I have therefore compared certain statements with the reports of the Bureau of Navigation for verification. The results will appear in the regular course of this discussion.

The general question of the training of apprentices for the United States naval service has always been a subject of great interest to me, and after an experience of nearly five years on board of United States cruising training-ships, I claim that I should, at least, have some ideas of the merits and demerits of the present system. Such ideas as I have, however, are radically opposed to those expressed by the essayist, inasmuch as he argues from the premise "that the present system of dealing with apprentices and their disposal after leaving training-ships should be greatly modified or abandoned," while I argue that the present system, *if carried out as provided for in the regulations*, will entirely provide for the faults that the essayist deplores. I shall attempt to logically defend my position by a reference to the text of the essay.

The present so-called *system* of training naval apprentices is the result of experiments extending over a period of twenty years, and embodies the experiences of some of the best officers in the service. It has undergone many changes—from a service entirely afloat to a service almost entirely on shore. It has met with approbation and disapproval from the service at large and from the Department at many times during its career, but step by step, watching carefully the results obtained by the various experiments, there has been produced a series of regulations, a part of the "Regulations for the Government of the Navy, 1893," which still continue in force, and which have possibly undergone fewer changes than perhaps any other subdivision of these "regulations." My contention is, that proper, judicious administration

of these regulations will accomplish all that the essayist or the officers of the service could wish for. I therefore disagree with him in his belief that the present system "should be greatly modified or abandoned," and I will try to follow his essay paragraph by paragraph and show why the present system need not be "*modified*," much less "*abandoned*."

The essayist goes on to say, after making this statement about "modifying" or "abandoning" the system, that "the apprentices are often considered of no particular value on board of general-service ships, and that a good many of the commanding officers consider them a nuisance and bother. They seem to be used principally for messengers and signal-boys." Can this be considered the fault of the apprentices or of the system? Is it not rather the fault of the general service, especially of its commanding and other officers?

Paragraph 866-2 of the Regulations provides that "they shall not be detailed for duty as messengers for a longer period than three months," and if they are not efficient as signal-boys, it is more than likely that these same commanding officers will not continue *that* detail much longer than *three hours*. Now, it follows that if the regulations are carried out the apprentice need not suffer this drawback to his advancement—if learning to carry a message properly must be considered a drawback—for longer than three months. If, however, they prove efficient as signal-boys, and are continued on that duty, they certainly cannot be considered a nuisance and bother, but rather reflect the greatest credit upon one of the most important features of the system. Further, it is now provided that appointments to two of the three petty officer billets open to the apprentice upon re-enlistment, quartermaster 3rd class, and coxswain, are *dependent* upon the candidate's qualifying as a signal-man.

His second paragraph, beginning "After leaving the training-ship it appears that . . . the apprentices receive but little instruction or care, and that they are given at first too many privileges of men," etc., is quite provided for by the Regulations. Art. 867 provides that "the instructions of apprentices shall be continued in general cruising ships, as nearly as possible in conformity with the instruction on cruising training-ships"; and Art. 865-1 says, "On board cruising ships in the general service apprentices shall form a part of the regular complement," while Art. 868 provides for their "proper examination." It is unnecessary to quote the entire article.

In face of these regulations, I ask again, is it the fault of the system, or of the officers of the cruising-ships?

The essayist is quite right in exclaiming against one officer having examined forty apprentices in one day, and in saying that no officer of a training-ship could examine one-half of that number in one branch alone (seamanship and gunnery) in this time.

No officer can *properly* examine one-sixth of forty apprentices in any one branch in any one working day. In the last cruises of the training-ship Portsmouth we allowed each officer the four or five weeks necessarily at sea in returning home from Madeira and the latter part of the

West India cruise, to examine 108 to 140 apprentices in one branch alone; an average of but four a day.

Now as for his objection about their being granted too many privileges of men, it is my sincere conviction that one of the greatest faults, not only of the system of training naval apprentices, but *naval cadets* also, is that they are treated too much as *boys* and not as *men*. It is not the place, and I have not the time, to enlarge upon this perhaps radical view, but the complaint of the service in regard to the boyishness, the lack of manliness of both apprentices and naval cadets, results from this ridiculous conception of their relation to their life's work.

The entire paragraph in regard to whether or not the apprentice suffers by joining a ship that has a small part of its commission to serve, or whether it is better to join a new ship, can, in my opinion, be safely referred to the same query—Is it the fault of the apprentice system or of the officers? It is true that the officer exacts too much of the apprentice, and I am afraid that it always will be so. Again the fault of the officer.

The use of the steam launches can certainly not be laid to the apprentice system. The father of the apprentice system as it practically stands to-day, Admiral Stephen B. Luce, absolutely forbade the presence of steam launches on board of cruising training-ships, and my last three years saw the apprentices manning all the running boats (and there were many of them); they were exercised at oars and sails besides; not as often, perhaps, as I should like to have seen them, but still in a condition, upon our return from a cruise, to pull a good oar, to intelligently take part in the sailing of a boat, and able at any time to respond to a call for such services on board any ship in the service, except perhaps as coxswain of a barge or steam launch, provided that a reasonable allowance be made at the *first call* for their inexperience with the ways of the new ship and their shyness with their new shipmates.

"The study of the system of enlisting and training apprentices in foreign services," etc., *certainly* "furnishes food for thought." While there is a great difference between the people of the United States and those of Europe, it is not necessary to confine ourselves to the compulsory and voluntary aspect of the case. In England, especially, there exists a condition of affairs which is almost without a parallel in this country. They are essentially a maritime people, and there exists an element of society which may properly be said to *breed* seamen. In very many of the densely populated seaport towns there are families, many families, who for generations have provided sons for the merchant and naval marine. There are mothers who beget *seamen*, and the pride of many a household is in their "Jack," serving beneath the red or the white ensign of his country.

I cannot agree with the essayist that "there is an opening for every young man." On the contrary, I believe it is hard now-a-days for an industrious, sober, steadfast and talented young man to get a job, particularly such a job as his industry, sobriety and talent should demand. The United States naval apprentice job calls for just such elements of

character, and attaches "no degradation of social status" in an ordinary or any other sense. No degradation attaches to any one who wears the honored livery of his country, be it a taped shirt or a gold-laced coat.

The balance of the "introductory" part of the essay seems to turn on the social question. There are social grades in all countries and communities. There always have been, and it seems likely there always will be. To my mind the naval apprentice should be taken from that social grade where three warm meals a day, a comfortable bed at night, an assurance of steady employment, and a solvent paymaster constitute the ideal life, *and never above* it. When you pass above this stage you are apt to meet with boys who, unless particularly well balanced, will be likely to suffer by the contrast and become discontented. There is a very broad field, however, covering the social grades *below* my standard, from which you may seek for and obtain sufficient material to fill any and all vacancies that may arise in the apprentice service. Apprentices from these classes are likely to always be better off than those they leave behind them, so far as the comforts of life are concerned, and are certain, as they mature in years, to be more and more contented with their lot.

There is a wide gulf between my grade and that grade of society which is, as a class, generally tainted by crime and viciousness. Should the mistake be made of enlisting an apprentice from this last class, the doctrine of heredity plainly teaches us that the existence of a vicious or mischievous taint in any subject will soon manifest itself, and Arts. 852 and 858 of the Navy Regulations provide for this "weeding out the undesirable boys," both at the station and on the training-ships, so that the general service is relieved of much of the viciousness and, in many cases, of the mischievousness that might otherwise burden it. Let the apprentice come from such grades of society as suggested above, and it is unnecessary—yes, it is wrong—to hold out to him a station in life the requirements of which in a social way he has never had the training for, and probably does not instinctively possess. Much better is it to have him feel that he is assured of a comfortable living and an honorable consideration from his country than to have him constantly regretting that he does not seem likely to become an admiral.

I now come to the essayist's subdivision, "Enlisting Apprentices, and Inducements." His first statement is shocking! to wit: "It must be quite evident that when only ten to fifteen per cent. of the naval apprentices enlisted remain in the service, something is wrong with the system." Quite true, but will he admit that there would be anything so very wrong with the system when twenty-five to thirty per cent. remain permanently in the service, determining to make it their life profession; and when 85 per cent. of the naval apprentices enlisted serve out their period of enlistment and reach the age of 21? To say the least, the Government has been well repaid with the services rendered by these minors, and should be satisfied with the twenty-five to thirty per cent. remaining; but it has in addition the satisfaction of

knowing that those who leave after the expiration of their apprenticeship are on shore, generally near the coast, a trained body of experienced young men; ready at any time to respond to the country's call for men to go on board ship; already familiar with the life, its duties, its pleasures and its hardships; a foundation upon which to build the volunteer system that our Government seems to rely upon so strongly for its national defense.

As I have said, the other statistical paragraphs I have not been able to carefully look over; the above, however, have been verified.

Now, as regards that paragraph which says "not sufficient attention is paid to good character and moral qualifications," etc., I have to state that the report of the Chief of the Bureau of Navigation furnishes me further with the fact that in 1892, of 2290 apprentices who were examined, only 830 were accepted; in 1893, of 1650 examined, only 646 accepted; in 1894, of 1862 examined, only 561 accepted; and in 1895, of 1920 examined, only 348 accepted, a total of 30 per cent. of acceptances from those examined, and these entirely exclusive of doubtless hundreds of candidates who have been rejected from their general appearance, not upon the records as examined candidates, boys so manifestly vicious, deformed or otherwise undesirable as to permit the recruiting officer to pronounce prompt judgment.

If I am wrong in inferring that the essayist has any suspicion of *could* when he says *would* in his statement, "With a reorganization of the seaman branch . . . such that a larger number of men *would* obtain continuous-service certificates . . ." there would have been no need of looking into the matter of C. S. C's. But feeling intuitively that such an idea lay behind his words, I looked up some points and can only ask what could be more liberal than the present law? The number of the C. S. C's is limited only by the number of enlisted men allowed in the service. Every man re-enlisting within three months, with a recommendation for such re-enlistment, is entitled, and all apprentices re-enlisting within three months of their reaching the age of 21 are entitled to a C. S. C. upon application. Preference is always given to the ex-apprentice when considering the applications for the "permanent appointment" and for instruction in the gunnery class, while the warrants of gunner and boatswain are, by law, preferably given to candidates from among the ex-apprentices.

My time is too limited to expand upon the thoughts which every sentence almost of this essay suggests to me in criticism. Either I must be decidedly a crank on the subject, or else during the last year the condition of things on board the training-ships must have very materially changed. This is said without anything more than a reference to the fact that the essayist seems not to have as thoroughly weighed his statements as he ought to have done in preparing an article for the U. S. Naval Institute Proceedings.

He suggests that "inducements and regulations for enlisting somewhat similar to the following be adopted." These suggestions are numbered from 1 to 12 inclusive. Now I find that No. 1 differs materially from

Arts. 836 and 841 of the Naval Regulations only in that the regulations call for the age limit of 14 to 17, while the essayist suggests 15 to 17. I honestly think the change is in favor of the essayist.

No. 2 is already provided for in the Supplement to the Revised Statutes of the United States, Vol. I., 1874-1891, p. 263, Secs. 1420 and 1624, as well as by the Navy Regulations.

It seems to me that so far as No. 3 is concerned, any boy who says he is between 15 and 17 years of age, but who is less than 5 feet high and weighs less than 100 pounds, is so likely to attract attention as to be at once classed with those candidates who fall beneath the personal judgment of the recruiting officer.

Nos. 4 and 5 are especially provided for in every particular by Art. 841, par. 3, Navy Regulations, as well as by the Revised Statutes.

Nos. 6 and 7 I quite agree with, but Nos. 8, 9, 10 and 11 seem to me too absurd to be worth an extended criticism. If naval cadets, after the four years of careful, progressive training in the elements and elegancies of the naval profession, fail to pass that examination which it is necessary to pass to become graduates of the Naval Academy, can it be thought possible for an instant that a young man entering the apprentice service at 17, and after spending four years in the performance of his duty as a naval apprentice, with little, if any, opportunity to study—can it be thought possible, I repeat, that one could be found who might "undergo the same examination as the graduating class of naval cadets"?

Laying aside the consideration of the purely technical studies which are required at the Naval Academy, the standard for graduation in most subjects, except the classics, is on a par with, if not above, the standard of any educational institution in this country.

Presuming that a young man leaves college at 17—the upper limit at which he could become a naval apprentice—his four years of apprenticeship would have to be devoted not only to retaining what he has already learned, but in acquiring that thorough knowledge of the naval professional studies which makes the course at the Naval Academy so remarkably good.

No. 12 I quite agree with. It fits in my platform. If everything else had been done as prescribed by law, probably neither this article nor its criticism would have appeared.

I cannot but admire the departure of the essayist from his ordinary path as he begins his subdivision, "Training of Apprentices." It is excellent, full of thought, and, to my mind, beyond criticism. He is right about the importance of providing the newly enlisted apprentice with a well-fitting outfit of clothing. Many a sensitive boy has had his ardor dampened, if not his intention to desert then and there formed, by reason of the jeers of his comrades when he appeared in a jumper reaching nearly to his knees, with sleeves turned back two or three times, and trousers resembling a pair of flour-bags open and turned up at the bottom. The essayist is also right when he says, "The matter of always being strictly in uniform should be a strong point in the train-

ing of apprentices." My experience has been that it always *was* a strong point. I speak positively in regard to the last ship in which I served, and I challenge the broad statement which he makes, that "they are found right on the training-ship," unless times have changed.

The regulations for the ship's tailor on board the training-ship Portsmouth required that every article of clothing made by him for men or apprentices should be first submitted to the divisional officer, and each divisional officer must critically examine each piece, and with a foot-rule verify the top of the crown of the hat, the width of the band, the width of cuffs, and in fact strictly apply all the requirements provided for in the clothing regulations of the service.

I recall a complaint made by the commanding officer of a cruising-ship that an apprentice from the Portsmouth had come on board with a highly non-regulation suit of clothing. I was a member of the board appointed to look into the matter, and we learned that not an apprentice in the draft had left the ship in any other than the regulation clothing, nor had the last bag inspection revealed the possession of any non-regulation garments among any of the apprentices. But we also learned that the accused apprentice had had a fancy crow-footed suit, with a starred and many-colored cap, made by the ship's tailor, with which to dazzle the eyes of his parents and friends while enjoying his furlough, and had appeared on board the said cruising-ship with his suit, possibly encouraged to do so by the existence of non-regulation clothing, especially caps, among the enlisted men with whom he was thrown. This led on board the training-ship to the issuance of an order forbidding the tailor to make at any time, for anybody, any article of non-regulation clothing, on penalty of losing his job on board that ship.

No; it is on the cruising-ship and not on the training-ship that the charge of not being "strictly in uniform" applies. It can almost be said that at the naval training-station there is absolute ignorance on the part of the apprentices of anything but strictly regulation clothing. Were his experience afloat and abroad of the same kind, the temptation for ti-ties, crow's feet and stars, would never be presented

I do not think that the present system as employed at the Naval Training Station at Newport, under the existing circumstances, can be much improved upon. It is certainly the intention, if not the practice, of the Department that apprentices should remain at the station fully six months before being drafted to the training cruising-ships. This is so nearly the case that it is perhaps well to simply explain to what degree it fails to be exactly the case. A division consisting of 108 apprentices exists on the books of the training-station for six months, taking this date. I understand, from the departure of the Alliance and Essex on their respective cruises, they breaking joints, as it were, as nearly as possible. When the division of 108 apprentices is complete, no more are enlisted for that division, but a new division of 108 is started, so that most of the division of 108 are at the Training Station fully six months, only those who chanced to be enlisted among the eighties, nineties or one hundreds being at the station less than six months. Some may be there longer.

The recommendation for the two sailing brigs is a most excellent one —a much to be desired one. As he alludes, no one who has lain at anchor in the harbor of Plymouth, England, and seen the little brigs sailing in and out each day, having the possibilities of training in every requirement of the deep-water cruising-ship, except perhaps sea-sickness, can but feel and appreciate their great value for training purposes. It has always been a source of wonder to me that in the many appeals to Congress which the advocates of the training system have made, there has not appeared and been fought to a finish the building of two such brigs.

And now, passing on to the subject of the essayist's subdivision of "Training Ships," I would only say that I think torpedoes and the study of electricity might better be reserved for more mature years. There should be electricity for lighting purposes, for health and convenience, and especially for signal instruction and exercise, but I should do no more than leave the dynamo-rooms open at certain times for the inspection of those apprentices who from motives of curiosity, inspired possibly by an inherent taste for these mysteries, might desire to at least ask questions.

The idea of two specially-built ships is of course a very good one, but the essayist has not been emphatic enough in insisting upon a covered deck. *It is an absolute necessity.* Failing, however, to secure any special appropriation for these training-ships, I think that light spar-decks on the Alliance and Essex, with an engine-room bulkhead that can be taken down when not steaming, and hatches to cover the engine-room hatch, would answer the purpose for some time to come. They seriously fail of their purpose as they are now, with open spar-decks.

As to the battery, I can see no necessity for two 6-inch R. F. guns, for more than two 4-inch R. F., two 6-pounder R. F. guns, and so on. I should certainly have 3-pounders and 1-pounders, revolving cannon, field 6-pounders, a Gatling, Maxim, Nordenfelt, and in fact a specimen of every known arm, large or small, in use or suggested for use in the service. I say two 4-inch R. F., etc., that both the Driggs-Schroeder and the Hotchkiss types may be included. The gun-deck should not be regarded entirely as a battery-deck, but a model deck as well, a lecture-room, and so far as possible, photographs and models of armor plate, models of projectiles, powder-bags, all kinds of powder, smokeless and otherwise, and in fact every detail of the ordnance profession should be at hand for inspection and use as an object-lesson to the apprentices. Target practice might be so arranged that an apprentice should fire at least one shot from each of the calibers below 4-inch, and those apprentices making the best records with these guns might be put to the 5-inch and 6-inch guns, to further refine the competition. With a view to the great importance of target practice I should have the 6-inch R. F. on the spar-deck and the 4-inch and 5-inch permanently mounted in the forward and aft ports of the gun-decks respectively, for purposes of daily drill. All other guns should be so mounted that they could be shifted to the spar-deck during target practice, and permit, also, of drill exercises.

It is a great pleasure to find myself so thoroughly in accord with the essayist in his views in regard to the importance of the *sailing ships*, but a pity that I fall to carping at once because he does not let himself loose on it. It is an all-inspiring theme, an all-important one to his subject, and I regret that my limited time compels me to talk quick, but I can't let the subject pass without recording the fact that I view its importance as second to none other in our naval profession both now and in all time to come.

It is my sincere belief that square-yard and sail training is the corner-stone and cap-stone of the seaman and officer as much to-day as in the times of John Paul Jones or the studding-sail-boom hero of Cooper's novel. It is the all-in-all, the without which neither officer nor man has any more right to the title of his profession than has a doctor who has never visited a hospital to hang out his sign and aspire to practice. To depart in the slightest degree from the utmost practice of seamanship aloft and on the bridge, as the foundation of a line officer's education and training, is to hazard his unquestioned claim to command; to withhold a single chance from the naval apprentice handicaps his value as a helmsman or a gunner, deprives him of that development which will carry him with firm-set nerves right up to and through the dreadful crisis of the ram or the torpedo.

Away with your sails, if you please, strip your masts of their yards, but after you have done so, produce me a man to compare in fertility of resource, in keen judgment, in fearlessness, in dash, in courage, in leadership, in all that makes a manly man, with the one who has been trained at the weather-earring or in smothering the mad billows of a thrashing sail! You can't do it.

There is a something about the sailing-ship sailor which marks him from his mates of the shovel and oil-can on board ship, a something that shows itself at the gun, about the decks, on shore; a manliness, an independence, a something that catches your eye when looking for volunteers, a something that responds when you call for them. Few men are naturally fearless, still fewer born with a ready wit to meet emergencies as they arise. There is but one school to properly teach those who follow the sea in their country's service, and that is the school of the top and the cross-tree, the surging yard and the bellying canvas. It is calisthenics and morals combined, and far be the day when sails, yards and masts cease to be the main features in the primary training of the naval apprentices.

As a school for the young officer, too, nothing can ever give him that habit of observation, that attention to detail, that self-reliance, that readiness to meet the calls of the minute that are the constant companions of the officer-of-the-watch on a sailing ship. No better school for learning the strength and weakness of men as a class, for studying and appreciating character, for getting "work out of men," as the saying is, than on the deck of a sailing ship, and the essayist does well to call attention to the importance of the sailing ship for both officer and man. The two training brigs suggested would be a most excellent school. With

a lieutenant in command, and a detail of young officers to fill the duties of executive and navigator, as well as watch officers, short cruises of a few days might be made to the great advantage of the officers and apprentices. A ship's cook and a seaman in each part of the ship would be all of the experienced force needed forward, and an interested set of officers aft would soon develop the boys and bid fair to keep alive that class of men made glorious in history by their records of pluck and daring.

There is much that my limited time prevents my passing upon, either critically or otherwise, but I cannot pass the suggestions in regard to "amusements and non-professional instruction" without expressing my belief that it has perhaps as much to do with inducing apprentices to remain in the service as any other attraction, not excepting pay, that can be offered. The last three commanding officers of the Portsmouth were believers in this idea, and encouraged singing, magic-lantern exhibitions, horizontal bars, Indian clubs, dumb bells, and boxing gloves, and as a part of the daily routine, the piping of "all hands to play," whenever the weather permitted, during the evening hours.

A library of light reading, selected with a view to the apprentices almost entirely, was procured by the modest subscription of five cents a month from each officer, man and apprentice who was willing to subscribe, and the appearance of what was left upon the completion of the cruise attested the value which the boys placed upon it. Few, of the several hundred books purchased, were in a condition to be even worth sending to a hospital.

In the matter of food, the custom of commuting a certain number of rations and purchasing articles not covered by the regulation naval ration in addition, resulted in the fact that of over six hundred boys who cruised with me during my last cruise, there were not a dozen who complained at any time of the food, except in cases where some bully in the mess had ruthlessly robbed his weaker messmate of his allowance. This bespoke a contentment on one very important point. Different boys were detailed weekly to take charge of the mess. Their duties required them to set the tables, receive the ration from the ship's cook, distribute it, clean and restore the tables and utensils, and for this they were allowed in cash their 30 cents a day ration; provided, however, that the record of the mess utensils with which they entered upon their duties tallied with that which they turned over to their successors. Inasmuch as they bought their own mess gear, they paid for what was lost.

The suggestion for schoolmasters to accompany every division is unquestionably a good one. There should be a sufficient number of schoolmasters, or boatswain's mates, 1st class, at the training station to provide for at least two for each division of boys, who should be associated with it until it was drafted in the general service, and who should then be re-attached to a new division at the training station.

In regard to a permanent crew for the training-ship, the essayist emphasizes the matter of having men of good habits selected, and every-

thing should be done to encourage good men to remain on the training-ships. The commanding officer should further have the assurance that at the end of the training cruise any recommendation that he should make to the Bureau to that end should be immediately complied with, as it would be better to err on the side of perhaps removing a man who was only at fault in his example, by accident, than to have a new draft subjected to the possibility of being the witnesses of another accident. The force of example among boys of that age is very great, and the essayist thoroughly appreciates it.

I can only state in conclusion that the essayist has done a good thing for the service in opening the door for the discussion of this, to my mind, important feature of the naval establishment. I have not agreed with him in many particulars, nor do I expect that others will agree with me, but from all the discussions (and I trust they will be very general) there may arise a more catholic spirit towards the training system and its results than exists now. I have never been thrown with a more conscientious set of officers as regards the duty that was put upon them than in the training service, and I must say that I feel that most of the criticism which the training system has been subjected to has resulted from the failure on the part of the officers with whom apprentices were thrown after leaving the training-ship, from not knowing the regulations covering them, or else, knowing them, failing to properly administer them.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

ELECTRICITY IN NAVAL LIFE.

By Lieutenant B. A. Fiske, U. S. N.

$750,000,000 is the amount stated by *The Electrical Engineer*, after a careful investigation, to be the capital invested in the United States in the various electrical arts, such as the electric light, telegraph, telephone, electric railway, etc., etc. In examining the causes for the investing of so large a sum, we must conclude that either the people in the United States are a very unwise and visionary class, or else that electric appliances do really possess some qualities which contribute to their comfort and happiness in a practical way.

In examining the results of the use of electricity in naval life, we must admit that, up to the present time, electricity has fulfilled all the promises it has given us. It has made our ships brighter, cleaner and healthier; it has lightened the task of enforcing discipline; it has increased the accuracy of gunnery; it has made instruction interesting; it has assisted the surgeon in diagnosing wounds and relieving pain; it has given the captain better control of his ship, and the admiral better control of his fleet; it has added an element of intelligent interest and expectation to each new addition to our Navy, and it has brought into active sympathy with the sea-going class a large and influential body of progressive men on shore.

The enormous development of the use of electrical appliances in all countries of the civilized world, and the beneficent effects resulting, are bearing practical fruit in naval life. The experience gained by electric railway companies, electric light companies, telephone companies, telegraph companies, and all the other thousand and one branches of business in which electricity

is used, has proved that electrical apparatus may be relied upon provided two conditions are fulfilled. The first condition is that the electrical apparatus shall be designed to meet the particular circumstances of each case; the second is that it shall be cared for by men who understand it. The increasing confidence shown in it by naval authorities has been particularly evident in France, where numbers of ships have been constructed in which electric power is used to do almost all the work heretofore done by auxiliary steam engines.

The principal difficulty that electricity has had to meet in our Navy has been the fact that there has been very little incentive for officers and men to study it; so that most of those who have become proficient (enlisted men as well as officers) have gone into civil life, and we find them distributed among the various colleges and electrical enterprises of the land. There they are doing good work for the country and are making honorable reputations for themselves, but, so far as helping the Navy goes, their services are lost. So it is not surprising that electrical apparatus has come into use in the Navy so much more slowly than it has come into use in civil life; but it is surprising that it has come into use so rapidly as it has, and exhibits a more progressive spirit than seamen are usually credited with possessing.

It is frequently stated that the reason for the slow progress of electricity in naval matters is the difficulty of meeting the conditions of ship life; but this position is hardly tenable, because the conditions for the use of the electric light, electric motors and telephones in war-ships are in reality not nearly so severe as they are in hundreds of positions along the coasts of the country and through the long stretches of the mountainous and comparatively unpeopled sections of our western lands. In reality there can hardly be found, outside of the college laboratory, conditions which are in many respects so favorable as those to be met on board a modern war-ship. In the first place, the distances through which the electric current are to be transmitted are extremely short; in the second place, the item of expense does not control to so great a degree as it does in the operations of commercial life; in the third place, in case of any accident or derangement, the place where this accident or derangement occurs is always within a few feet of somebody, so that it will not have to be hunted for, as frequently happens

with apparatus on shore, through miles of country; in the fourth place, the solidity of the structure of a ship and the excellence of all of the mechanical appliances are in great contrast with the flimsiness of the structure and the cheap character of the installation which have, for financial reasons, in many cases to be made on shore.

About ten years ago the writer had occasion to deliver a lecture before the Franklin Institute, on Electricity in Warfare, and about four years later, another on the same subject. In the first lecture the operations of electricity in warfare were almost wholly hypothetical and promissory. In other words, the effort of the lecturer was to point out what electricity might be made to do, perhaps. In the second lecture he was able to state with some positiveness that some things could be done and, in fact, that some things had been done. In the present paper he takes pleasure in stating that certain things have actually passed official tests in sea service, and he will confine himself to facts without indulging in any flights of the imagination. To emphasize the difference between the state of affairs obtaining now and the state of affairs obtaining at the time of the first lecture, it may be said that at this first lecture there were present a commodore and a captain of the United States Navy, both officers of high ability and character, and, in a conversation after the lecture, they pointed out the impossibility of using the electric light on board ship by reason of the impracticability of getting sufficient space for the dynamo. In spite, however, of the successful efforts of the Genius of Electricity in ameliorating the conditions of shipboard life, there are still many objectors, and it is a fact that a contest is going on between electro-mechanical and other mechanical apparatus in very many of the important operations in ships and forts, which promises to be as lasting and as bitter as the contest between steam and sails; and yet it is easy to one who watches the drift of modern engineering practice to see with which the ultimate victory will reside. Just now the fight is going merrily on, and the public benefits by the competition. No sooner does an electrical device score a success than some ingenious person does the same thing with mechanics; and no sooner does an important mechanical invention accomplish some new thing than an electrician throws it altogether into the shade by a novel use of electricity. It may

be stated as a general law—but with the distinct understanding that it is only general—that mechanical appliances have the advantage of greater simplicity of principle, and that electrical appliances have the advantage of greater simplicity of operation. To paraphrase this statement, mechanical appliances are more easy to understand, but electrical appliances are more easy to use. Mechanical appliances require less instruction for their use; electrical appliances render available a higher grade of intelligence and also require a higher grade of intelligence. Electrical appliances strive for an idea; mechanical appliances do what is required at the moment. The advantages of maturity and experience are on the side of mechanical apparatus; but youth and the promise of the future reside with electricity. Mechanical appliances are less apt to deteriorate from disuse; electrical appliances are less apt to deteriorate from use; mechanical connections are liable to give out under the sudden strain of emergency; electrical appliances, from their nature, suffer little strain in use and are not apt to fail in emergency if found to be in good condition before the emergency occurs. A mechanical connection, if broken or injured, gives plain sign of the whereabouts of the trouble, but the trouble is with difficulty repaired. A trouble in an electrical connection is sometimes hard to find, especially if the apparatus is not thoroughly understood, but when found, is remedied with ease. The difficulty of repairing a break or disarrangement of a mechanical appliance, caused by a stress, is usually in proportion to the greatness of the stress; but with electrical appliances, the cause of trouble is usually minute, and can be repaired as soon as found.

A very important enemy of electrical appliances on shipboard has been the "fatal facility" with which bad electrical apparatus can be installed. It has always been so easy to run a wire or to put in a battery, or a bell, or a dynamo, which would work for a week, that in very many cases it has not worked any longer. Good work on electrical apparatus often seems so unnecessary that slipshod work is substituted, and it does as well as any other for a while; but suddenly the apparatus fails, and then one hears on all sides complaints of the untrustworthiness of electricity. Nevertheless it is a fact that the naval and military uses of electricity are increasing. The same reasons that have filled modern cities with telephones, telegraph, electric motors and

electric lights, are filling our modern war-ships and fortresses with them. The same reasons that gradually replaced the club of the savage with the magazine rifle of the modern soldier are operating to replace the simple but clumsy ships and battery of a few years ago with war-ships of tremendous power but vast complexity. It seems to be a law of nature that we must pay for what we get. If we will have monstrous engines of war, dirigible with precision and rapidity, we must use complex machinery, protest as we may.

There is one very important phase of this question to be considered, and that is, that in this feverish march of progress, one must either keep up or fall behind; and a navy must either keep up or fall behind. This state of affairs becomes more and more acute the farther the march of progress proceeds; and the view may be extended even farther, so that we can see that the more complicated ships and weapons become, and the more education and instruction and drill are needed for their efficient handling, the greater advantage will rest with that navy which devotes to them the needed education, instruction and drill; provided always that the increase of power of offense and defense is sufficient. This statement may be put in another way:—In any apparatus which bestows vastly improved powers of offense or defense, mere complexity is not a disadvantage to any navy which devotes sufficient time and labor to mastering the difficulties, because the very fact of its complication gives that navy great advantage over navies which cannot or do not master the difficulties. This indicates the principal advantage of the civilized soldier over the savage. The civilized soldier is no more brave than the savage, and very often is under the greatest disadvantage by reason of lack of acclimation and of knowledge of the country. But the complicated arms and organization of the civilized forces are too much for the brain of the savage, and he is forced to retreat before the complications of civilization.

This argument is not intended to prove that complexity has of itself advantages over simplicity, because simplicity is the perfection of efficiency, as it is of beauty. It merely points out that the part of wisdom of a highly civilized nation is to develop weapons of the highest possible power, and to educate the officers and men to handle them. An hour every day taken from

the merely routine work which highly educated officers of middle life are compelled to do, would show us that our profession is not only one of the most glorious in the world, but one of the most interesting, and would give us an opportunity of keeping up with the progress of the times.

In describing broadly the uses of electricity in naval life, many uses, not strictly new, must needs be included. The subject may be divided somewhat as follows:

Electric Lighting.—The electric light is now a *sine qua non* in modern war-ships. The principles previously laid down have been proved correct in practice, and the present development is along the lines of an increasing supply of lights and the gradual improvement of the details of wiring and insulation. The number of officers and men acquainted with electrical things has naturally increased, and this has brought about a better functioning of the apparatus used, as a necessary result. Search lights of automatic feed, controllable from a distant point, have proved practicable; considerable diversity of opinion still exists as to whether they should be high above the water or low down, but the advocates of high positions are gaining ground. No important change has taken place in signal lights.

Electrically Operated Steam Whistles.—These have been recently tried in both war-ships and merchant-ships with promising results. They do not interfere with the ordinary method of sounding the whistles, so that their use seems to confer a distinct advantage with no offsetting disadvantages.

Motors.—The use of electric motors is clearly on the increase, especially for ventilating, the training of turrets and the hoisting of ammunition. Perhaps the advantages of electric power over steam are more obvious in the matter of ventilation than in any other field, the principal gain being in the fact that the necessity is avoided for the tremendous air ducts which take up so much room in coal bunkers and living spaces, and the substitution of a number of comparatively small ventilators, each placed where it is wanted, instead of the large steam blowers for which room is so hard to find. The military advantage of the small electric ventilator is one that may easily be overlooked; but it is a well-known fact that in many ships the steam blowers have had to be placed above the water line and absolutely unprotected; which means that in the early part of an action

the blower supplying one or more of the magazines may, and probably will, be put out of operation by a very insignificant cause, making it absolutely impossible for the men to remain in the magazines.

For training guns, the practice of employing motors is becoming limited to turrets, the mechanism being arranged in such a way that hand power can be used in case of accident. As regards the relative advantages of the three principal powers, steam, hydraulic, and electrical, a wide diversity of opinion exists. The great desideratum of simplicity resides, of course, with steam, and many regard this feature as of paramount importance. Others, however, while admitting the superior simplicity of steam, and while admitting the enormous value of simplicity, point out the extreme difficulty of securing a "dead beat" motion with steam, even if a worm and screw be included in the mechanism. They also point out what at first sight may not seem an important point, but which may readily become so—the question of heating; insisting that, no matter what mechanism may be employed, it is after all "the man behind the gun" on whom we must rely, and that the man behind the gun and the men in the passing rooms will not work at their best in an unendurable heat.

The principal advantage of hydraulic engines over steam and pneumatic engines, arising from the incompressible nature of water, is the absolute rigidity with which they hold the turret. If the valves are closed, the turret cannot move; and the turret can never make the water motor go at a greater speed than that for which it is set. In the sighting hood, the continuous turning of a wheel by the operator at any desired speed controls, on the floating lever principle, the speed at which the turret shall go. The muscular effort required is so considerable that he is compelled at frequent intervals to move his eye from the axis of collimation of the telescope, which is almost fatal to fine shooting. Now electrical men show that they can attain fully as much nicety and precision by electric means, using a controlling switch so easy to move that the eye can be kept continuously at the telescope until the instant of fire; and, furthermore, they proceed to point out how pipes burst and valves leak just when called upon to work. In most, if not all of the plans hitherto tried for electrically training turrets, however, control

of the motor's speed has been sought through the putting of more or less resistance in the circuit of the armature. The difficulty of handling large turrets by this means is of course great, and the means thus far employed can hardly be called satisfactory. They do not need describing here, because in fact they are bad and should not be used. In determining why they are bad, let us consider what is needed in order to control the training of a turret in a sea-way. The turret weighs a hundred tons or more, and it is rare that its center of gravity is in the axis of rotation. As the vessel rolls from side to side, the turret tends to move by its weight in one direction or the other, the effect being at a maximum when the guns are pointing ahead or astern. Let it be supposed that the turret is pointing ahead and is stationary, and that the turret captain wishes to train it to point at a target on the starboard beam. He moves his lever to the front and the turret starts to turn slowly, the great mass of the turret preventing its suddenly taking up a rapid motion. Just now the ship begins to roll to port and the turret has to climb up hill, besides being accelerated. As the roll continues, the hill becomes steeper, until it reaches a maximum, and then it becomes less and less steep, until an even keel is reached. This has taken—say, eight seconds, and the turret has just about reached the speed at which it is intended to run, when the ship starts to roll to starboard; the turret now tends to run down hill, and the motor is doing its best to help it. Evidently, the arrangement of the motor must be such that without any conscious effort from the operator, the turret will not be permitted to run down hill, for the mass is so great that the consequence of mental confusion or inattention on the part of the operator might be serious. In other words, the motor must be arranged so that it cannot run above a certain speed. This is usually expressed by saying that we must use a "constant-speed motor."

It has been objected frequently, however, that constant speed is not needed, or even desired; that what is wanted is simply ability to get the turret quickly around to the target, and to move it quickly to the right or the left in order to keep the guns pointing at the target.

Without wishing to detract in any way from the importance of these points, it must be insisted that everything should be

done to make the gun captain's work easy, that his mind should be as free as possible from mental calculating, his lever as easy to move as practicable, and that the movement of the turret should bear a definite relation to the movement of his lever. Let us suppose that this is not done and that the turret's speed depends on other causes than the movement of his lever. Is it not plain that the captain will have to jerk his lever around more frequently and spasmodically than he would if each position of his lever meant a certain speed? If each position of his lever can be made to mean a certain speed, regardless of everything external, is it not plain that with a little practice, and even if the gun captain does not know anything in figures about either the position of his lever or the revolutions of the motor, he will yet insensibly come to feel that he with his own arm is moving the turret, and that his own will controls its speed? Can he not then follow a moving target with far greater precision than would be possible if the turret would spasmodically speed up or down from moment to moment as the ship rolled?

It is not an answer to this to say that it is impossible to get constant speed under the circumstances, that the speed and direction of the turret must frequently be changed, that it will always take a certain interval of time for the heavy mass to make the change, and that during the interval the speed of the turret will be either increasing or decreasing. This objection, while it includes a true statement, is really misleading, because it amounts to saying that, if perfect control of any machine cannot be obtained, we should therefore refrain from attempting to make the control of the machine as perfect as we can. To attempt the control of a turret in a sea-way is like trying to solve a problem containing many variables; and it is axiomatic that the solution of any such problem is easy in proportion to the reductions we can make in the number of variables. Applying this principle, we are forced to the conclusion that the motor for the turret should be so arranged that its speed shall vary as little as possible from the speed set by the gun captain. Now, it is not hard to get a constant-speed motor; but unfortunately for any given electric potential applied to an electric motor, there is only one speed that can be constant; so that, in order to make a motor run at different constant speeds, different potentials must be applied, and each potential must itself remain

constant during the interval of time for which the corresponding speed is desired. In other words, in order that the gun captain in the sighting hood may be able really to command the speed of rotation of the turret, he must be provided with a system by means of which the potential which he applies to the motor shall not change, unless he himself intentionally changes it. Reverting now to the statement made before, that all methods of controlling turret motors are bad in which resistances are varied in the armature circuit, we see at once that it must be bad if the potential applied to the armature terminal is liable to change. That it is liable to change is easily proved, as follows:

If an electric motor is running at any speed, and if its load be suddenly increased by any cause, such as in this case, by an increase in the heel of the ship when the turret is running up hill, the motor tends to slow down; this reduces the counter electromotive force that the motor is generating and therefore increases the current in the armature. Now if a certain resistance (say $\frac{1}{10}$ ohm) has been put in the armature circuit when the armature current was 100 amperes, then, since $E = CR$, the voltage expended in heating this resistance $= 100 \times \frac{1}{10} = 10$ volts, and the voltage of the armature terminals falls from 80 volts to $(80 - 10 =) 70$, so that the motor is running really on a 70 volt circuit. Let now the load be increased so that the current increases to say 200 amperes; the voltage now lost in the resistance $= 200 \times \frac{1}{10} = 20$ volts, so that the motor will run at 60 volts instead of 70 volts. The action, then, of an increased load on the motor has been to decrease the power supplied to it, which is just the reverse of what was wanted.

In endeavoring to meet this trouble, Mr. Ward Leonard devised a system which is in use considerably for working large cranes and elevators. By this system, the speed of a motor is regulated by increasing the potential applied when it is desired to increase the speed, and decreasing the potential when it is desired to decrease the speed. To accomplish this, Mr. Leonard runs an auxiliary motor direct from the electric mains, and this motor has a dynamo of about the same size on its shaft, so that the motor turns the dynamo and makes it generate a current, which current goes to the armature of the motor that does the work. The magnetic field of this working motor is excited direct from the main circuit, and so is the field of the

dynamo which the auxiliary motor turns. But there is a variable resistance placed in the field of the dynamo circuit. Now by putting in more or less of this resistance in the field, the electro-motive force, generated and sent to the working motor, is decreased or increased, and the working motor is governed with astonishing precision. As the current, moreover, in the fields is always small, the great difficulty is avoided which always exists in putting resistance into or out of circuits having heavy currents.

One great objection to this method is the obvious one that two motors and a separate dynamo are required to do one motor's work, and the additional motor and dynamo must each be at least as large as the working motor. In the U. S. S. Brooklyn, two of the turrets are to be turned by electricity and two by steam, the idea being to have an absolutely fair competitive test under service conditions at sea. A novel plan suggested by the writer is to be tried which need not be described here, as it will not be interesting unless it prove successful.

Besides constancy in speed there are two other principal desiderata in the turning of a turret: first, sufficient speed of turning to bring the guns on to a target, and to follow it when its direction is changing, and second, extreme nicety of movement, which means ability to quickly move the guns in one direction or the reverse through small angles, and to stop it quickly when desired.

In deciding upon the speed required, the question resolves itself merely into deciding how much money and space can be provided for the power, because the highest speed attainable is desired. The speed, however, ought to be at least that necessary when two ships 1000 yards distant are passing each other at fifteen knots each, because this situation may nearly occur. Two ships passing each other at this distance and speed change their relative directions per second through an angle the sine of which is

$$\frac{(15 \times .57)\ 2}{(1000)} = \frac{17.1}{1000} = \sin 1^\circ \text{ (approx.)}.$$

This speed is clearly much less than would be required for handling the gun in a sea-way, having regard merely to the uncertain motion of the ship itself. So in our new ships, the speed specified is many times this, even under a considerable heel, when the turret will have to run up hill.

The problem of quickly turning the turret becomes afterwards one for the electrical engineer. He is told that the weight of the turret is so many tons, that the friction is so much, that the center of gravity is so many inches from the center of rotation, and that he must make the turret run at a certain speed. The question is so far one of horse-power. But he must also be told that the motor must be so designed that it will not become stalled (*i. e.* unable to move) under any probable roll, because, when a motor's armature is stationary the current through it is enormous, being ($C = E \div R$) that due to the potential between the mains (in the United States Navy 80 volts) and the ohmic resistance of the armature itself. To guard against an excessive current, in case an extraordinary roll should stall the motor, it is well to put an electro-magnetic cut-out in the armature circuit, which will automatically break the current if it exceeds an amount for which the cut-out is adjusted.

As it would be impracticable to provide sufficient power to maintain constant speed under heavy rolls, it becomes necessary to prescribe that the speed shall be constant up to a roll of say 10°, and permit that it may slow down when the angle of heel is greater, being careful that the speed shall never fall to zero under any probable circumstances.

The question of nicety of train, in the case that abundant power has been provided for the efficient rotation of the turret under ordinary rolls, is largely one of the construction of the switch which the gun captain moves. As the gun captain views the target through his telescope, the vertical and horizontal cross wires appear to be describing irregular curves against the background of the sky. His effort must be to bring these curves into the vicinity of the target. Though the motions of the cross hairs are seemingly erratic, they can, of course, be resolved into two motions, one horizontal and the other vertical. If the advance of the ship was in an absolutely straight line, and if the ship rolled the same amount from side to side and at regular intervals, the curve of the point of intersection of the cross hairs would be regular, and it would be comparatively easy to bring this intersection on to the target. But it is rare that a ship moves exactly in a straight line, in a sea-way, even when steaming on a certain course, for she yaws gently from side to side. Neither does a ship roll regularly. Even under the

best circumstances she rolls a little more to one side than to the other, and the rolls vary in amount from time to time. Then a ship frequently comes to rest for a while on an approximately even keel, and then starts to rolling again. Besides the rolling there is also the pitching, and this complicates the motion of the cross hairs, especially when the guns are pointing on the bow or quarter. The up and down motion is the quickest and the most irregular, so that the real problem is to so move the turret as to get the vertical cross hair on the target at the instant when the rolling throws the horizontal hair across the target, and to press the firing button at that instant, changing the elevation of the gun itself as little and as seldom as possible. With a large field in the telescope the vertical wire shows the direction in which to move the turret, even when the horizontal hair is several degrees above or below the target, so that the success of the gun captain, or rather of the man who is charged with the training of the turret in azimuth, in keeping the vertical hair across the target is dependent on the ease with which his switch can be moved, as well as on the response of the motor to the switch; and it is absolutely essential that the moving of his switch must not in the least disturb the position of his eye at the telescope. For this reason the motion of the switch must be to the front and rear, and not to the right or left.

Steering by Electric Motors.

This has been accomplished in several vessels, the most recent apparatus being in some "whale-backs" on our great lakes. The writer secured three patents some eight years ago on electric steering, but has not as yet had an opportunity to get his system tried. One of the patents covered broadly "the method of controlling electric motors whereby the motor follows the motions of the operator's hand in speed and direction," just as is done by the ordinary steam steering engine and the ordinary ash hoist. In the Brooklyn the experiment will be made of steering by electricity by means of what is called a tele-motor. The apparatus will be installed by Williamson Brothers of Philadelphia, who have made so many of the steam-steering apparatus for our new war-ships and merchant-ships that they may be presumed to understand the requirements of

good steering. There is more doubt, perhaps, about the advisability of using electricity for steering than for any other of the uses to which auxiliary engines are put in ships, because nobody wishes the steering machinery to be otherwise than absolutely reliable, and because steam-steering machinery is now so good that little is left to be desired. Electric steering, therefore, must at present be considered as doubtful, and the burden is on it to prove its value. Meanwhile foreign nations are also experimenting on it; and Messrs. Williamson Brothers do not wish to publish their own plans until they have achieved success.

Electrical Firing of Guns.

When one reflects that a vessel rolls from side to side in about eight seconds on an average, that even under very good circumstances she rolls more than one degree per second, and that with the modern guns an error of ten minutes of arc in the elevation of a gun above the horizontal at the instant it is fired means an error of about 200 yards in the distance the projectile will go, and that in the case of a ship 2500 yards distant this error of ten minutes of arc will throw the projectile about twenty-two feet above or below the point aimed at, we see that it is necessary to fire the gun in such a way that a less time than ten-sixtieths = one-sixth of a second of time will elapse between the time that the gun captain makes up his mind to fire the gun and the time that it is actually fired; unless the gun captain resorts to the method of firing his gun before his cross hairs rest on the target, by an interval of time which he estimates will be such that when the gun is actually fired the cross hairs will actually rest on the target. Of course, this method is often used with great success, and a "born shot" can, with sufficient practice, so use it; in fact, "born shots" do successfully use it, but only "born shots" can, and even they need more practice than is given or can be given in any navy in the world. To place accurate gun firing within the reach of ordinary men, electrical firing is used, in which the captain can fire without taking his eye from his telescope (or sights), and by such a slight pressure of his fingers that he can fire very quickly after making up his mind to fire, and (which is fully as important) without moving his eye from the telescope. Practi-

cal results show more accurate firing with electricity than with either percussion or friction. Complaints are sometimes heard of the untrustworthiness of electrical firing; but if electrical firing apparatus is properly installed, it is more simple and trustworthy than any other means. The real trouble is that as yet there are not enough people on shipboard who understand electrical apparatus. As to the concentration of fire by electricity, it has few friends and they are thinning out rapidly, as the system serves no useful purpose.

The advantages of electrical firing over percussion and friction firing are therefore two-fold. First, the time elapsing between the instant when the gun captain makes up his mind to fire and the instant when the gun actually is fired is very much shortened; second, the gun captain is able to keep his eye on the line of sight until the gun is actually fired, because, since his fingers alone have to act, his head is not jerked to one side, as it is by the physical effort of pulling a lock-string. These advantages are not very evident in the case of firing by the use of the ordinary bar-sight, because the gun captain stands several feet away from it (the bar-sight), and his line of sight is so uncertain that a little more uncertainty does not seem to make much difference. But the whole matter is changed as soon as one comes to look through a telescope sight, because then the line of sight is so absolutely defined that one knows exactly what he is pointing at, and he sees just as soon as he tries to pull a lock-string that by the time he gets the lock-string pulled his telescope sight has been moved by the motion of the ship, so that it no longer points at the same thing at which he pointed when he made up his mind to fire, but points at some other place. A long essay might be written to prove the reasonableness of electric firing, but it would not be half so convincing as a single look through a telescope sight when the ship is rolling, even as slowly as one degree per second. A change of one degree in elevation, let it be remembered, means a change of about 1000 yards in range on the average.

The details of electrical firing have given a good deal of trouble, but they seem pretty well worked out now. It is to be hoped that every "bug" will soon be overcome, because otherwise (since foreign navies are so successful with electrical firing) the U. S. Navy will have to give up its pre-eminent reputation for

fine gunnery. The single wire system is the one adopted in our Navy, in which one end of the fine platinum-iridium fuse wire, which is heated by the firing current, is electrically connected to the metallic body of the primer. As one pole of the firing battery is connected to the metallic carriage holding the gun, and as the metal of the primer is in contact with the gun, the circuit is completed when the gun captain presses his firing button; then the current heats the fuse wire, and the heat communicated to the primer ignites it and fires the charge.

The idea so long mooted and so much tried, of firing an entire broadside by the electric current controlled by the captain, seems rapidly falling into disfavor. There are so very many chances of failure, there are so many connections required, and the result hoped for seems so small an improvement over broadside firing by order, that "*le jeu ne vaut pas la chandelle.*"

Telephones.

The telephone is gradually making its way against the speaking tube. The latter has the advantage of simplicity of principle, the telephone of distinctness. The speaking tube is less apt to get out of order; the telephone does better service when it is in order. The speaking tube is more difficult to lead through the devious labyrinth of the compartments and it occupies valuable space, and while the telephone is not difficult to keep in order, the connecting wires sometimes get disconnected. The telephone has not as yet had a fair chance on shipboard because it is comparatively recently that the long-distance "solid back" transmitter has been introduced. So far as the writer's experience goes, the persons who are not acquainted with this telephone prefer the speaking tube, while t persons who are acquainted with both prefer the telepho

The principal disadvantage of t te
is one that it possesses in common t s
is, that it is a very inefficient instrument
under excitement. With both the i tu
phone clearness of articulation and a voice t t
necessary, if the message is to be quickly a
understood at the other end, and m u
sure to speak loudly and not very ly.

mission of orders, therefore, and for signaling to the engine rooms, helm and guns, visual indicators are coming into use. Visual indicators possess, besides the advantage of distinctness, the additional advantage that they do not add to the noise on shipboard and are not affected by it, and that the message which they bear remains in evidence until it is replaced by another message, so that "the last order" can always be referred to by a glance of the eye.

The writer has been engaged for some years in perfecting a system of electric apparatus for use in ships and forts which has of late emerged from the experimental stage and seems to contain the possibility of considerable usefulness. Most of this apparatus is based on a central principle of construction which aimed to avoid the inherent difficulty of previous electrical apparatus when used in or near sea air. This difficulty was apparently a trivial but really an almost insuperable one; the sea air attacked and corroded the metallic contacts with which the apparatus was filled. In nearly, if not all, the electrical apparatus used for signaling, the mechanism consisted of a train of wheels which were moved by a pawl and ratchet; the pawl and ratchet being moved, in turn, by an electro-magnet which pulled the ratchet wheel down one tooth every time the current was made and broken. Even the simplest mechanism made on this plan contained many parts, most of them small, and the greatest care was needed to keep everything in order. The only safety lay in hermetically sealing the cases, and this was far from satisfactory and made the mechanism inaccessible. In endeavoring to find a way out of the difficulty, the writer conceived the idea of using only unbroken circuits, which were varied in strength by gradual variations and never by jumps, the variations being indicated by galvanometers and attained by the moving of a wiper over a continuous wire of high resistance. And, as any general discussion of the subject of electricity in naval life would be incomplete if it omitted to mention the labors of even the humblest worker in the field, the writer feels emboldened to introduce to the Institute certain efforts of his own which, with two exceptions that will be designated, have passed official tests in service and are now in use in some of the new ships and are to be installed in others. Beginning with the simplest, he respectfully presents—

THE HELM INDICATOR.

The office of this instrument is to indicate instantly, at certain places in a ship, the exact position of the helm. This is accomplished by means of a device rigidly secured to the rudder post and electrically connected to any desired number of indicators.

The device secured to the rudder post consists of a strip of resistance wire, through which an electric current is passing and over which a metallic contact is moved by the helm; the indicators are galvanometers whose needles deflect to the right and left as the helm moves the traveling contact to starboard and port on the strip of resistance wire, the amount of the movement of said needles being proportional to the amount of movement of the helm and of the contact moved by the helm.

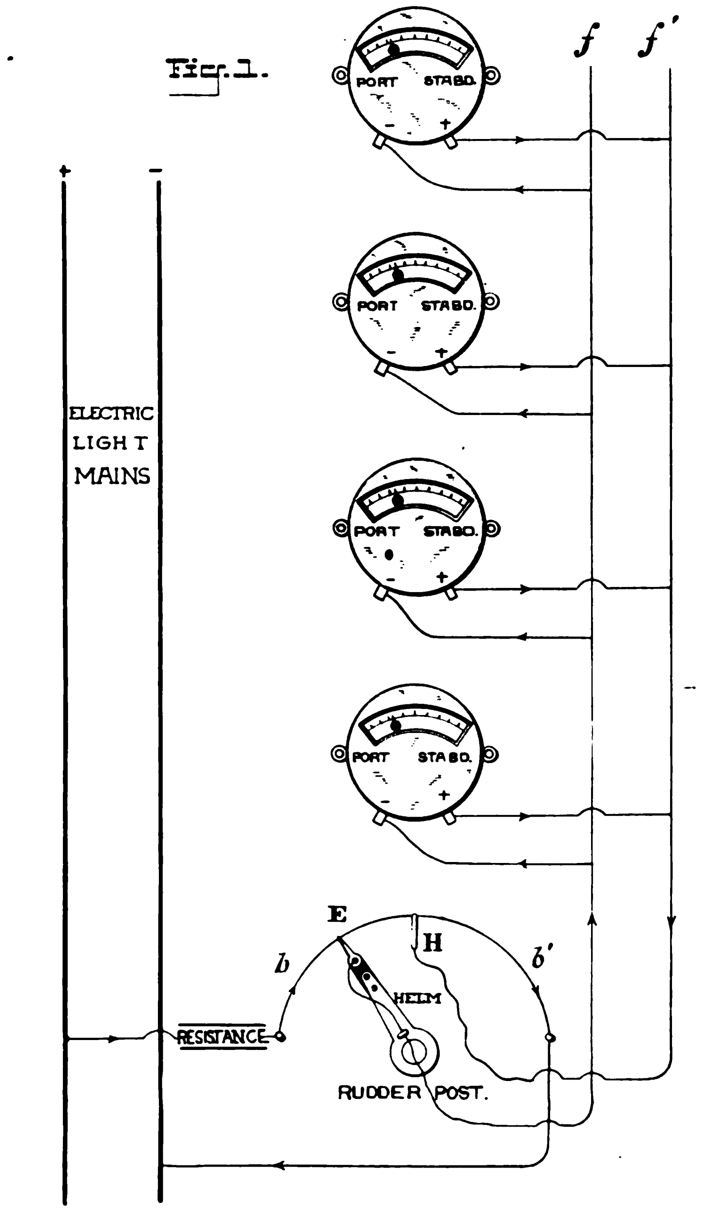
The principle of operation of the helm indicator is shown diagrammatically in Fig. 1. Attached to the helm and insulated from it is the metallic contact E, which continually presses on the arc of resistance wire *b b'*. At the middle of this arc of resistance wire is secured and soldered a permanent metallic contact H. When the helm is amidships, the traveling contact E rests on the permanent contact H, but it is moved to starboard and port of it by the movements of the helm.

A current of electricity continually passes through the resistance wire *b b'*. The current may be furnished by any suitable generator, such as a storage battery, primary battery, dynamotor, etc., but in the diagram it is shown as coming from the ordinary electric light mains of the ship, a suitable rheostat (resistance) being interposed to reduce the current to about 2 amperes. The immediate cause of any current in a wire being a difference of electric pressure (or potential) between the ends of the wire, it follows that there is a difference in pressure between any two points on the wire; so that if a galvanometer be connected to any two points on the wire, a current will be diverted through the galvanometer, going from the point of higher potential to the point of lower potential. In Fig. 1, as the current in the wire *b b'* is going from left to right, as shown by the arrow-heads, the point at E is at a higher pressure than the point at H, so that any galvanometer connected to E and H will be traversed by an electric current in the direction shown by the arrow-heads and the needle will move to the left. If,

HELM INDICATOR

DIAGRAM OF ELECTRICAL CONNECTIONS.

Fig. 1.

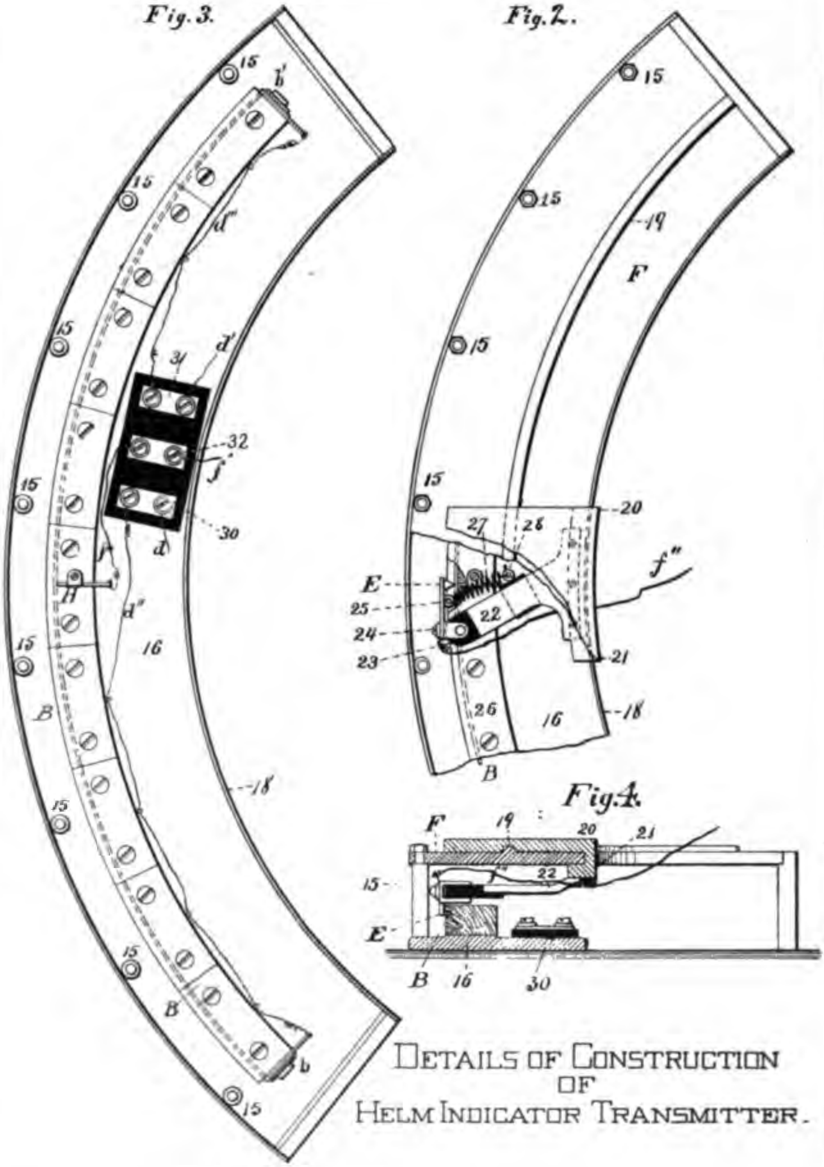


however, the contact E were to the right of H, it would press on a point on the wire which had a lower pressure than H, so that the current would flow through the galvanometer in a reverse direction from that indicated in the diagram and the needle would move to the right. If the contact E rested on H, as it does when the helm is amidships, the contacts E and H would have exactly the same pressure, and no current would flow through the galvanometer, and the needle would not deflect. In the galvanometers employed for this purpose, the position of rest of the needle is at a zero point in the middle of the scale.

In Fig. 1 there are four galvanometers connected in parallel (or multiple arc) to the wires f and f' which come from the contacts E and H. The reason for not connecting the galvanometers in series is that an accident to any galvanometer in action, or at any other time, would break the circuit and no galvanometer would operate. But if the galvanometers are connected in parallel, as shown, and if the wires f and f' are led below the protective deck, any accident to any galvanometer, or its leading wires, will cripple that galvanometer only. As the resistance of each galvanometer is about 60 ohms, and as the wires f and f' are of copper about No. 16 gauge, and the resistance of the wire $b\,b'$ is extremely small compared with that of each galvanometer, an accident to any galvanometer will not materially change the total amount of current. The current in any one galvanometer, and therefore its deflection, will increase slightly if any other galvanometer be injured and its current broken, but by an amount that is scarcely perceptible, never being more than 1° when the helm is hard over, and being nothing when the helm is amidships.

The resistance wire ordinarily used is the same as that used in the Fiske range-finder—an alloy of 70 parts of copper and 30 of nickel, nearly the same alloy as that used in the United States 5 cent piece. It is No. 22 gauge and has a resistance of about $\frac{1}{3}$ ohm per foot. It is laid in an arc, of which the center is the center of the rudder post and the radius is about 22 inches: the radius may be varied, of course, to suit different places.

In the apparatus constructed for carrying the wire $b\,b'$ and the contacts, called the transmitter, the wire is laid in a groove in an arc of wood, which is secured on a curved base plate of



DETAILS OF CONSTRUCTION
OF
HELM INDICATOR TRANSMITTER.

metal and covered by a similar curved piece of metal. The details of construction are shown in Figs. 2, 3 and 4; and Fig. 5 shows the method of securing the transmitter to the rudder post.

Referring to Figs. 2, 3, 4 and 5, the guide F is a curved plate of metal, supported by standards, 15, which rise from a base plate, 16. The plate 16, guide F and standards 15 form a box, or case, for the arc of wood, B, and movable contact point, E. Upon the upper side of the guide F is a rib, 19, which enters a groove in the under side of the traveling plate, 20. This plate has a flange, 21, which extends around the edge of the guide F. To the plate, 20, the tiller of the rudder is directly connected, so that, as the rudder is swung from one side to the other, the tiller will move the plate, 20, over the guide F. Or any suitable intermediate transmitting mechanism may be interposed between rudder and plate, 20, to cause the stated motion of said plate and contact.

To the flange, 21, is secured an arm, 22, the end, 23, of which is of insulating material and carries a pivoted bracket, 24, which supports a short arm, 25, on the end of which is the contact point E. The arc, *b b'*, of resistance wire is embedded in a groove in the edge of the wooden arc, B, which is secured by screws to the upper side of base plate, 16. Also to said blocks is secured the fixed contact point H. A spiral spring, 27, connected to the arm, 25, and to an eye, 28, held in an insulating block on arm 22, serves to hold the contact point E against the resistance wire *b b'*.

The wires *d* and *d'* are secured to plates 30 and 31, and from those plates the wires *d''* and *d'''* lead to the terminals of the resistance *b b'*. The wire *f'* connects to a similar plate, 32, and from this plate the wire *f'''* leads to the fixed contact H. The wire *f*, Fig. 5, is connected to a plate on the arm extending from the rudder post to the traveling plate, 20, and from this plate the wire *f''* leads to the contact piece E.

The resistance wire *b b'* should be kept covered with a thin film of oil, or vaseline. If this is done the friction of the traveling contacts will not cause the wearing away of the contacts or the wire, and the contact will move smoothly without jumping.

In case of trouble with this apparatus, the cause will be found in nine cases in ten to be a faulty contact.

In some cases the details of the transmitter have to be

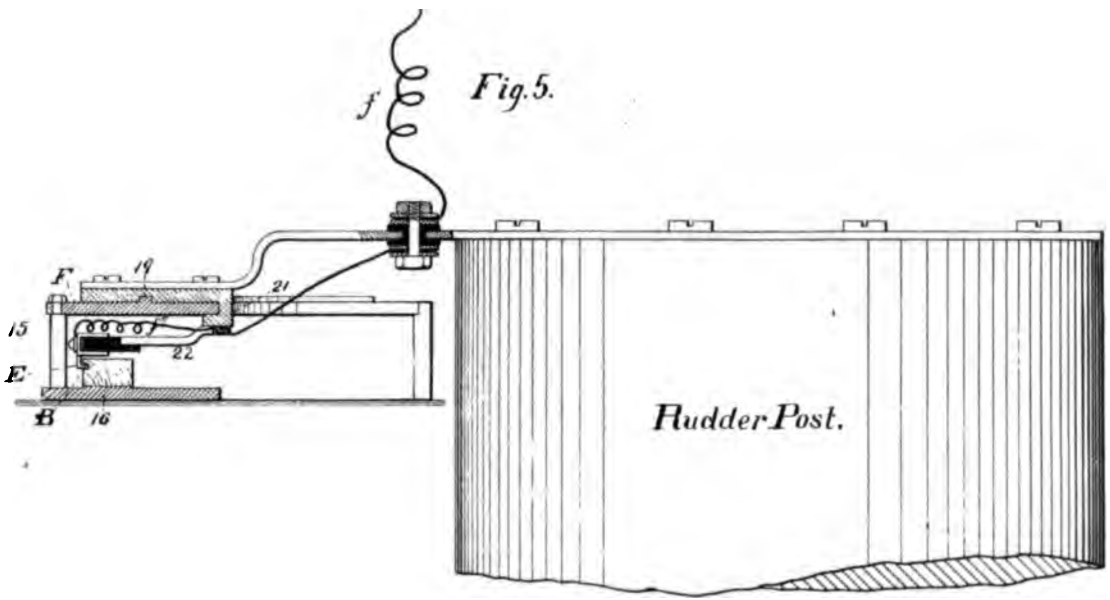


Fig. 5.

METHOD OF CONNECTING HELM INDICATOR TRANSMITTER TO RUDDER POST.

changed slightly in order to make it fit in certain places; for instance, the sliding plate, 20, sometimes has a flange fitting around the outside edge of the base plate, 16, instead of around the inside edge.

The galvanometer usually employed in the helm indicator, steering telegraph and engine telegraph is like that used in the Fiske range-finder and range-indicator and is illustrated in Fig. 6. The current passes through a light coil of wire in the form of a bobbin pivoted between the poles of a stout magnet, M. It is held normally at a position of rest in the middle of the scale by two spiral or volute springs, one at each end of the pivot. The effect of a current going through the coil of wire is to turn the coil in one direction or the other according to the direction of the current, and this tendency is resisted by the springs, so that the needle assumes a resultant position, in which the force of the springs just balances the magnetic force operating between the magnet and the current, the movement being small or great according as the current is small or great.

The galvanometer is mounted in a heavy water-tight case. In the helm indictator and steering telegraph circuits, the cases are usually made of heavily japanned cast iron, both for strength and for the reason that the iron case acts as an armature to the magnet inside, and decreases the effect of the magnet on any compasses in the vicinity. But an indicator should not, if possible, be closer to the compass than three feet.

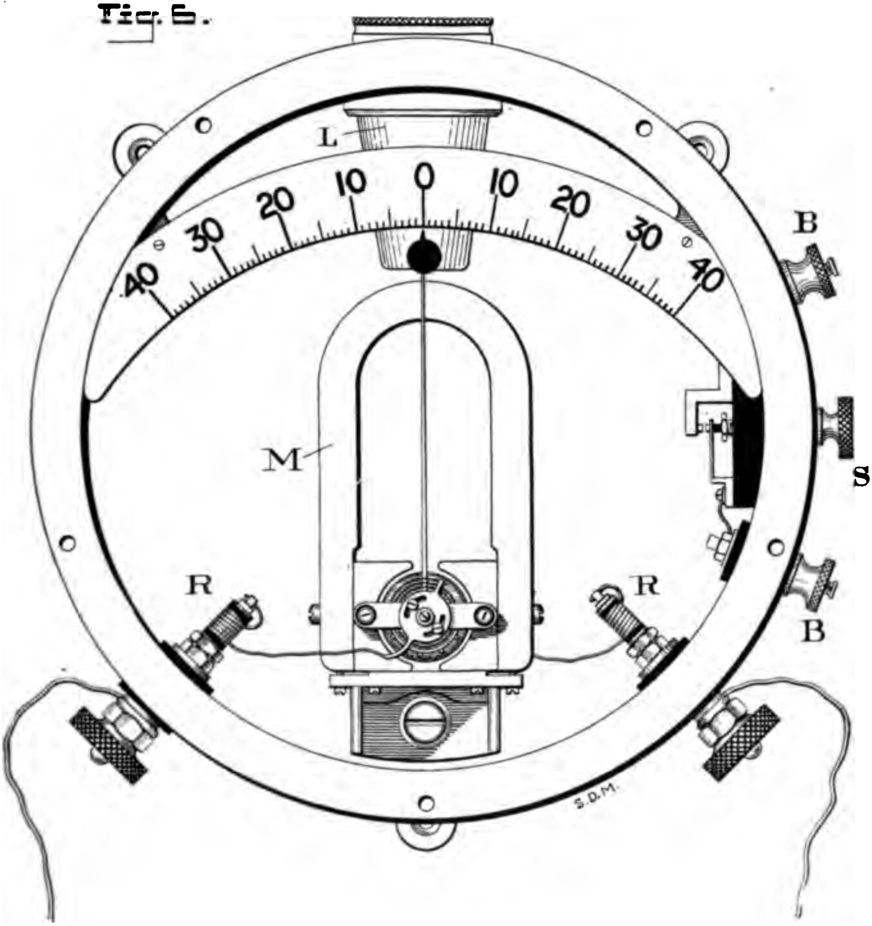
The iron cover carries under it a strong circular plate of glass, held on to it by an iron ring. The circumference of the glass is encircled by a rubber band, between which and the glass, white lead is placed to insure water-tightness. For the same purpose, white lead is thickly laid in the grooves for the glass plate in the cover and the iron ring, so that, when the iron ring is screwed on to the cover (the glass being between), the complete cover thus formed is itself water-tight. Before screwing the cover on to the galvanometer case, a rubber gasket is secured to the case by shellac. When the cover is screwed on, it forces the gasket into such intimate contact with the case that it cannot afterwards be pulled off without tearing. Shellac and white lead are omitted between the cover and the rubber gasket, in order to make it easy to take off the cover, if it becomes necessary. To make the cover water-tight, therefore, the cover must be screwed on tight.

GALVANOMETER

ARRANGED AS

INDICATOR

Fig. 6.



L = Incandescent Lamp

R R = Coils German Silver Wire For Adjusting Sensitiveness Of Galvanometer

Note.—In case a needle gets bent it may be straightened with the fingers. But if, when at rest, it does not point to o, and yet is straight, the trouble is that the little clamping screws near its pivot, shown in Fig. 6, have slipped. In this case these screws must be slackened and the needle turned carefully on its pivot until it points correctly, and then the little screws re-tightened.

A space of about $\frac{1}{32}$ inch is left between the glass and the outer iron plate in order to protect the glass against any blow that might be transmitted through the iron plate. To drain off any water that might run in between the glass plate and the iron plate, a quarter-inch hole is cut near the lower part of the iron plate. The helm indicator was given a year's test in service on board the armored cruiser New York. It has since been installed in the battle-ships Indiana and Massachusetts, using five indicators in each ship, the year's test having been passed successfully. It is now being installed in the Texas, and is to be installed in the Brooklyn.

To illuminate the indicators of the helm indicator and steering telegraph for night use, a small electric lamp L is introduced into the case as shown in Fig. 6. It lies within a stationary water-tight glass receiver, or globe, so that it can be taken out for inspection when desired, and replaced by another lamp, if necessary. The lamp may be lit by the current from a storage battery, or from the electric light mains of the ship, connected to the binding posts, BB, resistance being interposed to cut the current down to about $\frac{1}{3}$ ampere. The lamp is lighted by turning the water-tight switch shown at S, Fig. 6. The scale is printed on card-board secured on a brass gauze translucent backing.

The copper wires connecting the instruments should not be less in size than No. 16 American gauge.

Note.—Fig. 6 shows coils of resistance wire inside of the case for adjusting the sensitiveness of the galvanometer. Where extreme accuracy is required it becomes necessary to have an adjustable resistance outside the case as in the Fiske range-indicator, in order to compensate for sudden variations in the strength of the magnet due to changes of temperature. But this refinement is not considered necessary in helm indicators or steering telegraphs.

Weight of transmitter 35 pounds. Weight of indicator 22 pounds; diameter 10 inches, resistance 60 ohms.

The Steering Telegraph.

The office of this instrument is to telegraph from certain places in a ship to the steering wheels, the position at which it is desired to put the helm. This is accomplished by means of certain apparatus, called transmitters, placed where desired and electrically connected to indicators secured in conspicuous positions near the steering wheels. The principle on which the system depends is the same as that on which the helm indicator depends, the transmitters consisting of strips of resistance wire, through which currents of electricity are passing and over which traveling contacts are moved by an operator, while the indicators are galvanometers connected electrically to these contacts.

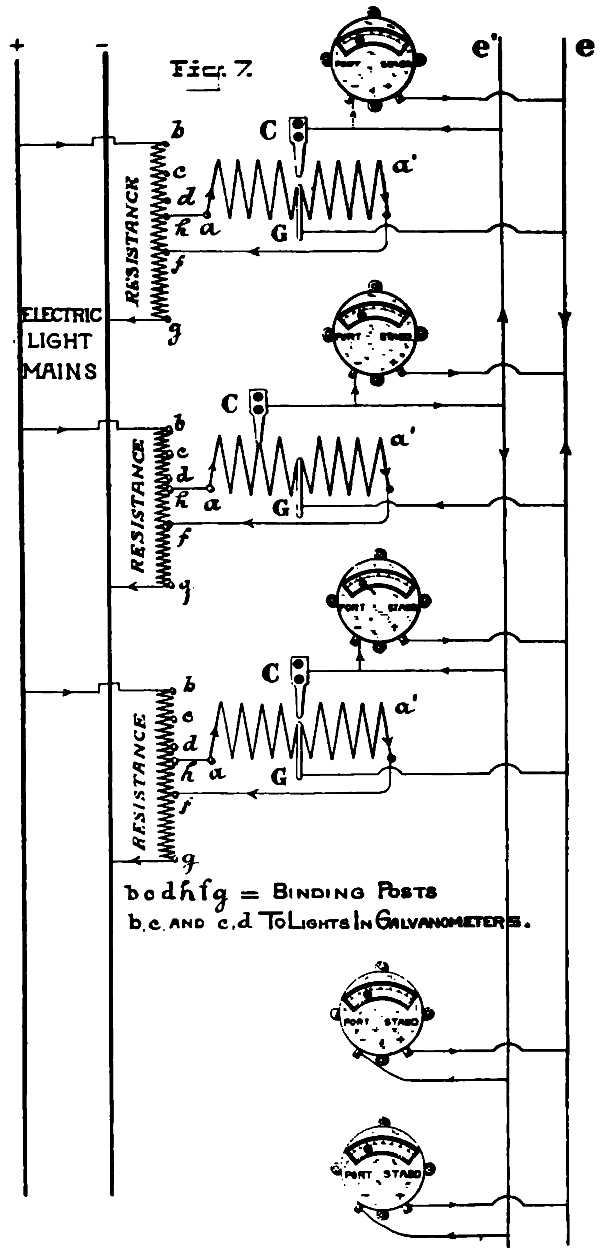
Fig. 7 is a diagram of electrical connections for a steering telegraph system, comprising three transmitters, shown on the upper part of the page, and two indicators shown on the lower part of the page.

The resistance wires *a a'* are traversed by currents of electricity, furnished by any suitable source, such as a storage battery, primary battery, dynamotor, etc.; in Fig. 7 the source is the electric light mains of the ship, a suitable resistance being interposed, as shown, to reduce the current in each transmitter to about 2 amperes. The passage of a current of electricity through the resistance wire of any transmitter, such as the second transmitter shown in Fig, 7, is immediately due to a difference in electric pressure, or potential, between different parts of the wire; so that the permanent metallic contact G and the traveling contact C are at different pressures or potentials. If the current is flowing in the direction represented by the arrow-heads, contact C is at a higher potential than G, so that a current of electricity will pass through any galvanometer connected to them, going in the direction from C to G and move the galvanometer needle to the left. If, on the other hand, C were to the right of G, it would be at a lower potential and the current through a galvanometer connected to C and G would go in the direction from G to C and move the galvanometer needle to the right. If the contact C were at the middle part of the wire and rested on G, C and G would be at the same potential and the galvanometer needle would remain at rest in the middle of the scale.

STEERING TELEGRAPH

DIAGRAM OF

ELECTRICAL CONNECTIONS



bcdhfg = Binding Posts

b.c. and c.d To Lights In Galvanometers.

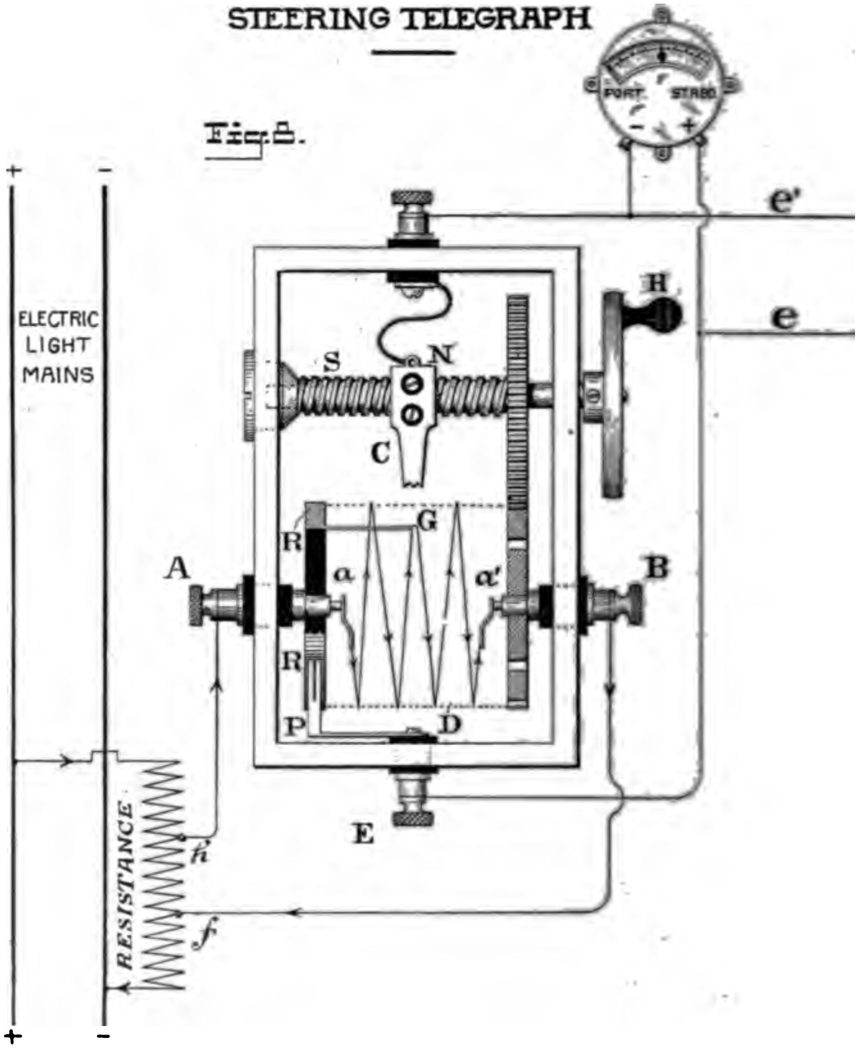
In order that two or more transmitters may be connected independently, and yet be so adapted that any one transmitter may be used at any time, the contact C and the wire G are so arranged that the contact C does not touch the wire when it is in its middle position. So long, therefore, as the contact C of any transmitter is in its middle position, that transmitter is not connected to a galvanometer and does not affect any galvanometer or any other of the transmitters. In the position shown in Fig. 7, the movements of contact C of the second transmitter affect the galvanometers just as though the first and third transmitters were absent. When not in use, the contact of each transmitter should be placed in its middle position, not touching the resistance wire. This caution is marked on each transmitter case. The amount of the movement of contact C may be shown on a graduated scale and the resistance in the circuit so adjusted and the galvanometers so marked that the galvanometer needles will point to the figure that indicates the movement of the contact C. This method is like that adopted in the helm indicator, but a preferred method is that shown in Fig. 7, because the system is not affected by any changes of electro-motive force of the generator, and the work of adjusting the resistance is avoided. By the plan shown in Fig. 7, there is placed in front of each transmitter a galvanometer exactly similar to the galvanometers which act as indicators at the steering wheels. The operator, then, at any transmitter, moves his contact until the galvanometer in front of him points to the desired helm position—say 20° port; and the two indicators at the steering wheels will instantly show 20° port.

A further advantage of the use of this galvanometer at the transmitter is that the operator always knows by its movements whether or not the apparatus is working.

In the absolute apparatus, as ordinarily constructed, the resistance wire *a a'* is wound in a spiral groove on the circumference of a cylinder D of insulating material, such as rubber, as indicated in Fig. 8. The two ends of the wire are connected to flat springs *a a'* against which press the ends of the binding posts A, B. The permanent contact G is connected by a short pin to a metallic ring R placed at one end of the cylinder; and a flat spring P connected to the binding post E continuously presses on the ring R. At the point where the permanent contact G is connected to the wire, the groove in the cylinder is cut

TRANSMITTER OF STEERING TELEGRAPH

Fig. 8.



down deep into the cylinder, so that the contact C cannot touch it. To accomplish this, in constructing the apparatus, the cylinder D is cut in half transversely, and the contact G, after being soldered to the wire which is to be wound on the cylinder, is secured in position. Then the two halves of the cylinder are screwed together and the wire is wound in the groove. To produce movement of the contact C, it is mounted on the nut N which travels on the screw S, C being insulated from N. The pitch of the screw S and of the spiral thread in the cylinder D are the same, so that, as S is revolved by turning the handle H (thereby turning D by means of the gear-wheels shown), the nut N is moved along the screw S, and the contact C along the wire *a a'*, the contact always remaining in the groove that holds the wire.

The copper wires connecting the instruments should not be less in size than No. 16 American gauge.

The transmitters of the steering telegraph are so arranged that any transmitter can be used independently of any of the others and produce the corresponding deflections in all the galvanometers, both of the transmitters and receivers, so long as both of the other transmitters are secured carefully at o; but any movement of any transmitter while another is in use is indicated immediately by the erratic movements of all the galvanometers. In order to show clearly when a transmitter is at o, a glass is placed in its face through which the sliding contact can be seen. When the transmitter is at o, the reference mark on the sliding contact is directly in line with the zero mark in the transmitter; and it can be secured in this position by means of a stout pawl which falls into a slot cut in the handle H, Fig. 8.

The steering telegraph was given a year's test in sea service on board the U. S. S. New York, and the test having passed successfully, the apparatus has since been installed in the U. S. battle-ships Indiana and Massachusetts, using in each ship three transmitters and two indicators. It is now being installed in the Texas, and is to be installed in the Brooklyn.

Weight of indicator, 22 lbs.

Resistance of indicator, 60 ohms.

Weight of transmitter box, 6 lbs.

Diameter of indicator, 10 inches.

STEERING TELEGRAPH.

TRANSMITTER.

FIG. 8 A.

THE ENGINE TELEGRAPH.

The office of this instrument is to signal to the engine-rooms the speed and direction at which it is desired to run the engines.

The telegraph for each engine consists of a transmitter and a receiver, in each of which is an arc of resistance wire. The ends of the resistance wires of transmitter and receiver are connected together by large copper wires, so that they form, with the galvanometer, a "Wheatstone bridge" circuit (see Figs. 9 and 10); and since the two arcs of wire are exactly similar, the galvanometer will not deflect, if the contacts to which the galvanometer is joined are placed on the resistance wires at similar points, such as 1.1, 2.2, etc. In the actual apparatus, the contacts of the galvanometer are attached to the levers on the instruments; so that, if the operator at the transmitter places his lever at any point, the galvanometer will not deflect, if the operator at the receiver places his lever at a similar point.

The operation, then, of using the telegraph is as follows:

The operator on the bridge, or in the pilot-house or conning-tower of the ship, wishing to signal an order, places his lever opposite the graduation on the transmitter indicating the order. The operator in the engine-room moves his lever until the galvanometer comes to zero, and then looks at the face of his receiver, to see the graduation opposite to which his lever then is.

Besides the galvanometer just mentioned, there is another galvanometer in series with it. This galvanometer is on the bridge, and is subjected to the same electrical current as is the galvanometer in the engine-room, and is moved to the same extent. The operator on the bridge, therefore, by looking at this galvanometer can tell whether or not the galvanometer in the engine-room is at zero; or, in other words, can tell whether or not the operator in the engine-room has moved his pointer to the signaled position; so that the galvanometer on the bridge acts as an answering signal to the operator there. The galvanometer in the engine-room is mounted in a vertical position on the lever of the receiver, so that the galvanometer and lever move together. (See Figs. 11 and 16.) Its electrical connections are such, that if the needle points in any direction, the act of moving the lever of the receiver in that direction will bring the needle towards zero. Furthermore, the sensitiveness

ENGINE TELEGRAPH

—— DIAGRAM OF ——

ELECTRICAL CONNECTIONS

Fig. 9

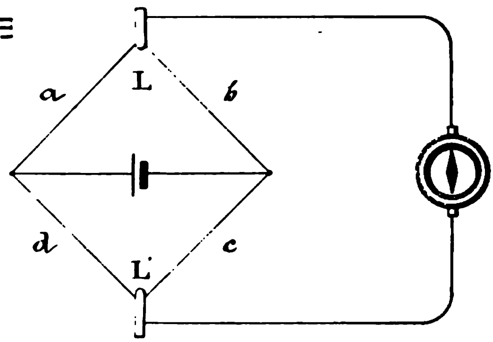
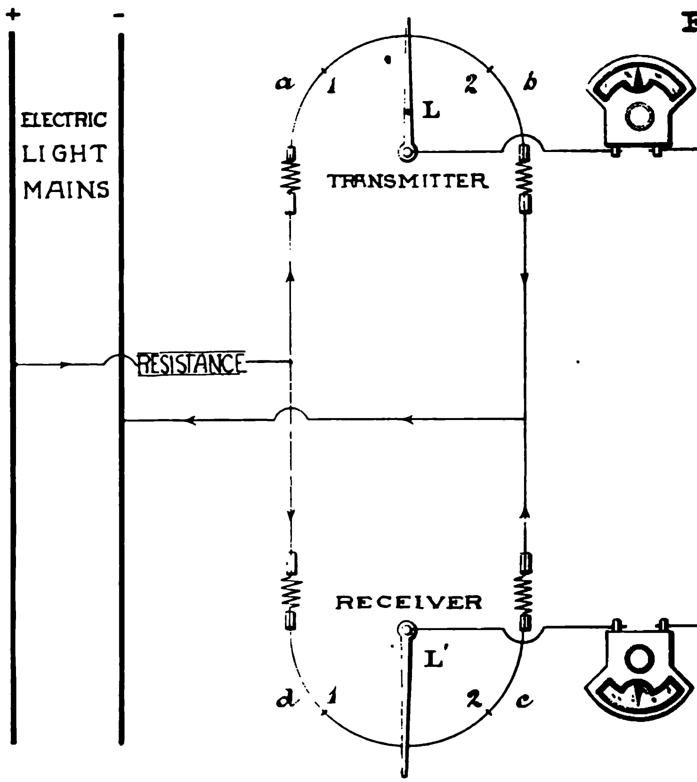


Fig. 10.



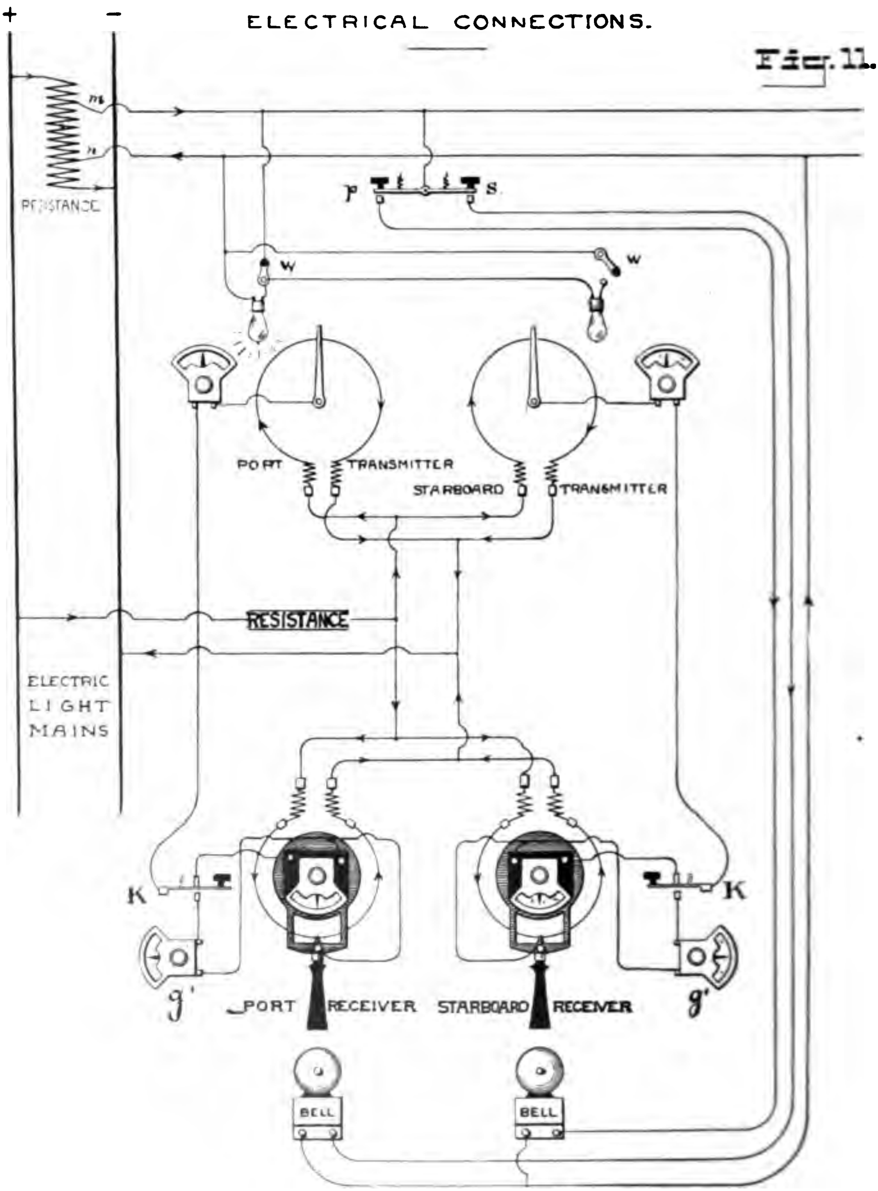
of the galvanometer is so adjusted during installation that the amount of deflection of the needle shows the amount of movement necessary to give the lever. If, therefore, the levers are at 75 and the transmitter lever is moved to 90, the receiver galvanometer will at once point to 90. When the needle is at zero, it is in a line from the center to the indicating finger on the lever; so that, in order to bring the needle to zero, the operator at the receiver moves his lever towards the needle and until it is directly opposite it. In other words, the mode of procedure of the operators, both on the bridge and in the engine-room, is the same as it is with the ordinary mechanical engine-telegraph.

The receiver's galvanometer, however, owing to the vertical position in which it stands, is not absolutely exact. It is possible to make with it an error of two or three revolutions. This error is of no consequence in the ordinary use of the engine-telegraph, but for squadron sailing greater exactness is desired. To insure this, an auxiliary galvanometer g' lying in a horizontal plane is placed directly below the receiver. (See Figs. 11, 16 and 17.) Ordinarily, this galvanometer is not in circuit, and no attention is paid to it; but if it is desired to get a careful reading, it is merely necessary to press the key K on its top and to move the lever of the receiver until its needle comes to zero. The act of pressing the key on top of this galvanometer puts the current through it and out of the vertical galvanometer which is ordinarily used, but does not disturb the galvanometer on the bridge.

The expression, " galvanometer needle comes to zero," means that the galvanometer needle comes to a marked position in the middle of the scale, but does not mean that it comes to its position of rest. There would be an objection to having the galvanometer needle come to its position of rest, to get the reading; because the needle will take its position of rest, not only when the receiving and transmitting instruments indicate the same thing, but also if the battery fails, or if the circuit is broken; so that the operators might think the system was in balance and operating properly, when, as a matter of fact, it was not operating at all, and would fail the first time they attempted to use it. For this reason, each galvanometer needle is bent away from the middle point marked on its scale, so that its

ENGINE TELEGRAPH

DIAGRAM
OF
ELECTRICAL CONNECTIONS.



position of rest is about $\frac{1}{16}$ of an inch from this mark; but the electrical adjustments are such that, when the levers of the transmitting and receiving instruments are at similar places, the "bridge" is not exactly in balance, but is out of balance just enough to bring the needles back to the middle marks or zero. Therefore, the fact of these needles being at zero is proof that the circuit is in balance, that both the transmitting and receiving instruments indicate the same thing, and that the whole apparatus is in perfect order. If, therefore, the operators at each end see that their needles are at zero, they know that everything is all right; but if at any time they see the needles are not at zero, they know that something is wrong. The first effort will naturally be to move the lever, in order to return the needle to zero, thinking that some person may have displaced the lever. But as soon as they see that this does not alter the position of the needle, they know that the instrument requires attention. *In other words, this system detects itself, if it gets out of order, and reports itself at once, instead of waiting until some one tries to use it* and then failing in an emergency, as mechanical telegraphs often do.

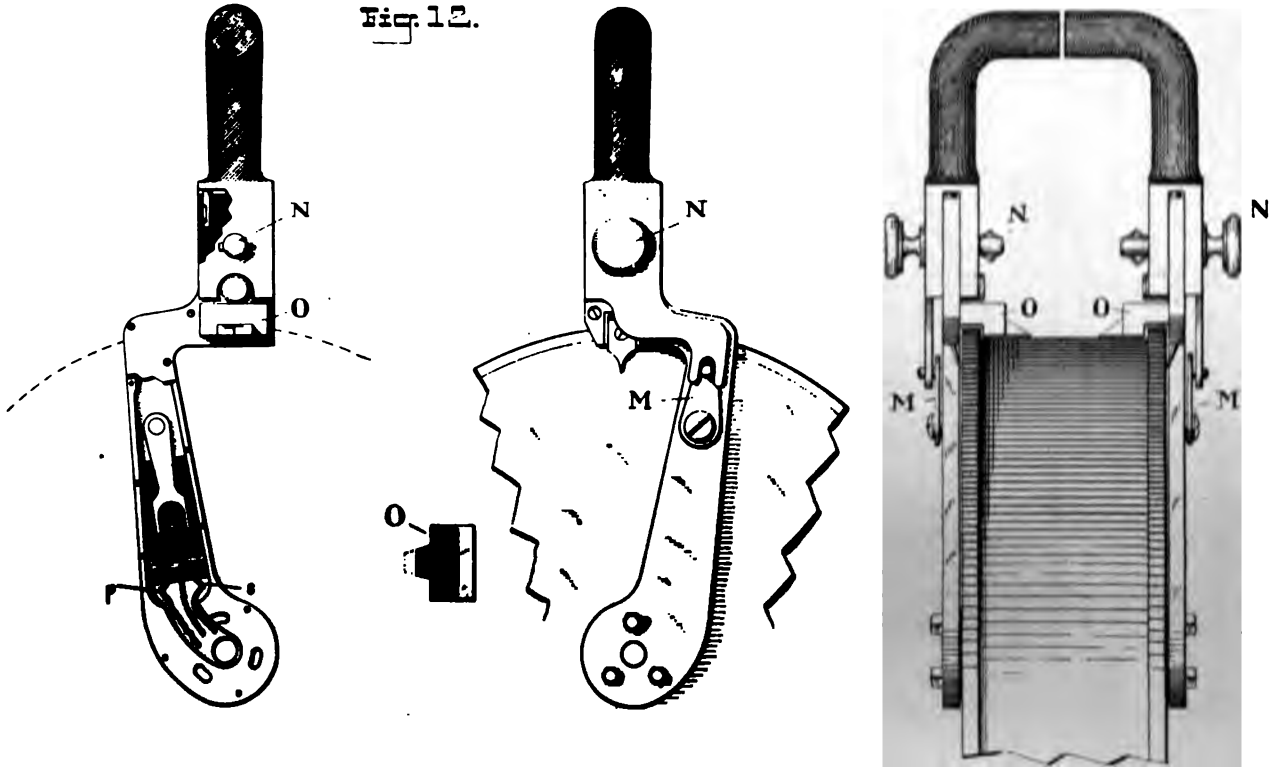
The apparatus may be operated either from a dynamo current or from a storage battery, or primary battery, or dynamotor. In Figs. 10 and 11 it is shown as operated from the regular electric light mains of a ship, a suitable resistance, about 38 ohms, such as a Carpenter rheostat, being interposed, to reduce the current sufficiently to make the galvanometers of the proper sensitiveness, which requires about 2 amperes, or about 1 ampere in each telegraph circuit, starboard or port, or ½ ampere in each resistance wire. As shown in Fig. 11, one pair of connecting wires is made to do the service of connecting both transmitters to both receivers. The resistance of each arm of the "bridge" is about 3 ohms.

The circuits of the bells and of the lamps which illuminate the transmitter are connected to the dynamo circuit through a resistance as shown in Fig. 11. The lamps for illuminating the transmitter are lit by turning the small screws W, Fig. 14, at each side, and can be taken out and replaced by others if found defective. These lamps are about 1 candle power, and are placed inside the reflectors shown on top of the galvanometer cases, *g*, on each side of the transmitter. The lamps and bells usually

TRANSMITTER HANDLE

—ENGINE TELEGRAPH—

Fig. 12.



ENGINE TELEGRAPH.

DOUBLE TRANSMITTER.

FIG. 13.

require about 10 volts each; so that the difference of potential between *m* and *n*, Fig. 11, should be about 10 volts.

Any part of the apparatus, including the galvanometers, can be taken apart, examined and repaired, if necessary, by a careful mechanic.

The arcs of resistance wire in the transmitter and receiver on which the contacts move are covered with vaseline before being installed, in order to prevent undue friction between the wire and the traveling contact. These wires should be examined from time to time and more vaseline put on as required. They should always be covered with a thin layer of vaseline or oil.

The act of grasping one of the handles of the transmitter closes the electrical contact P or S on the lever (see Figs. 11 and 12 and 14) by means of the lever M, and rings a bell in the corresponding engine-room. The bell contacts are covered in and arranged as shown in Fig. 12, and well protected from dirt and water. Water in these contacts will not close the circuit, but if they should get dirty they might not permit the closing of the bell circuit when desired. The transmitter handles may be taken off by pulling out the pin N. These handles are held in position on the rim of the transmitter by means of the spring friction piece in the sliding piece O.

In case of any trouble with the engine-telegraph, the difficulty, in nine cases out of ten, can be traced to some imperfect contact. The contacts most likely to require attention are those of the key K on the top of the small horizontal galvanometer *g'*, under the receiver. If these contacts fail to touch each other, the galvanometer on the bridge and the vertical galvanometer in the engine-room will not receive any current, and therefore their needles will not deflect.

A considerable amount of insulated resistance wire, about 2½ ohms, is added to each end of each arc of wire, as shown in Figs. 10, 11, 15 and 17, in order to increase the amount of resistance in circuit of this kind of wire, in comparison with the resistance of the copper connecting wires. This makes the resistance of the resistance wires in each arm of the "bridge" about 3 ohms. The reason of this is that copper changes in resistance with change of temperature, and it is not desirable to have changes of temperature to alter materially the resistance of the circuit. The resistance wires *a b* and *c d* are of No. 22 American gauge.

ENGINE TELEGRAPH.

DOUBLE TRANSMITTER.

Rear View.

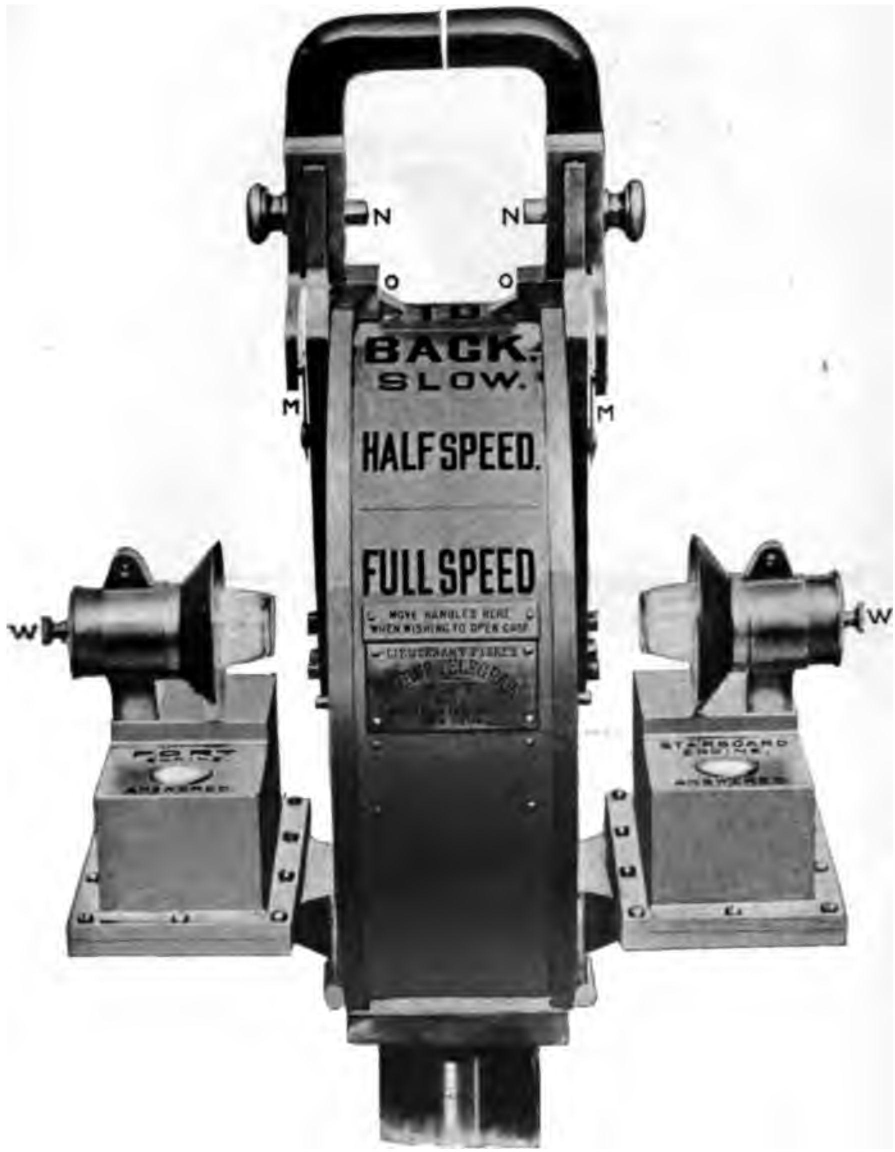


FIG. 14.

and made of range-finder alloy, *i. e.* 70 parts copper and 30 of nickel, with a resistance of about ⅛ ohm per foot. The copper wires connecting *a b* to *c d* are No. 6 gauge, being made so large to avoid copper resistance. The bell wires, galvanometer wires, electric light wires, etc., must be not less than No. 16 gauge.

FIG. 15.

As shown in Figs. 13, 14 and 15, both the transmitters are mounted on one pedestal and form a double transmitter.

When there is but one engine, the apparatus is correspondingly simplified and cheapened. In the case where it is not necessary to signal any exact number of revolutions, the graduations for revolutions on both transmitter and receiver, and the

ENGINE TELEGRAPH.

RECEIVER.

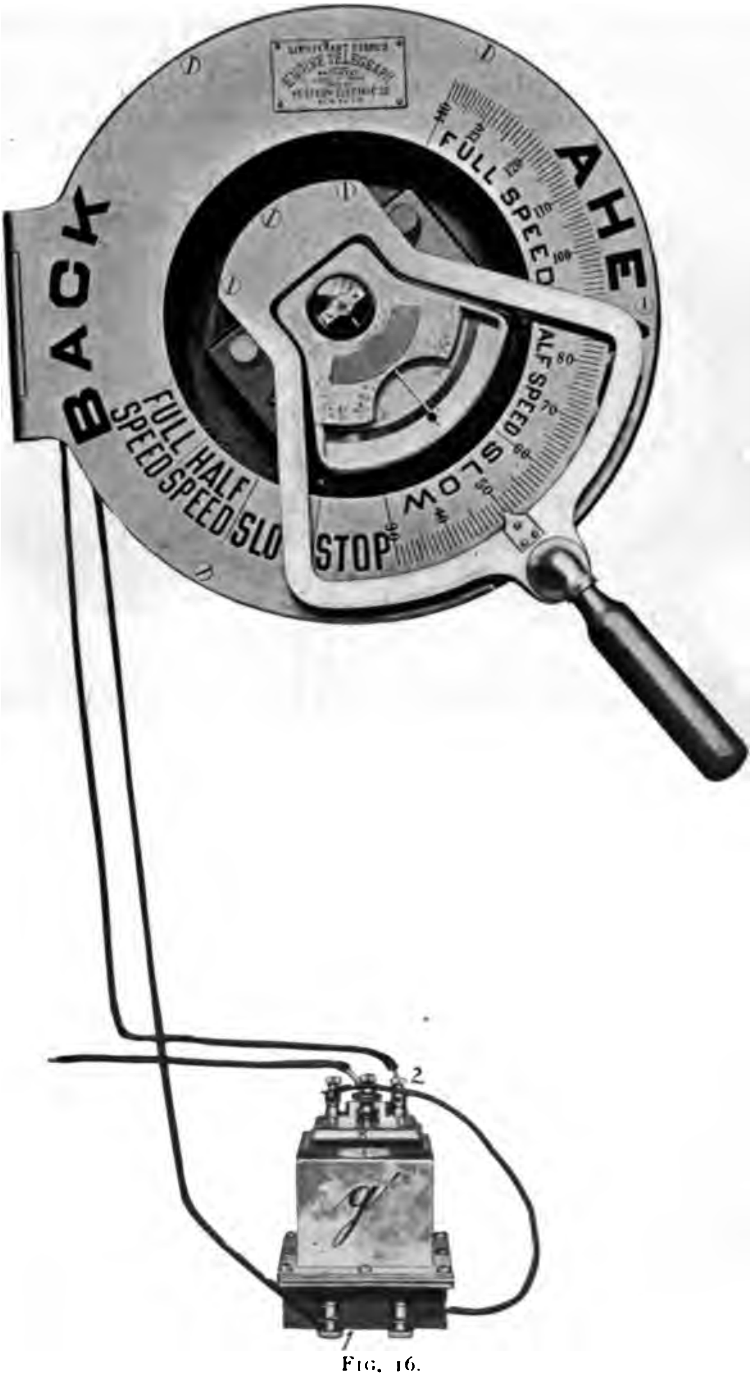


FIG. 16.

horizontal galvanometer g' under the receiver, may be omitted and the instruments made much smaller and cheaper.

In the case where more than one double transmitter is required, as in the Brooklyn, where three will be required, a switch is placed on the pedestal of each double transmitter, which carries

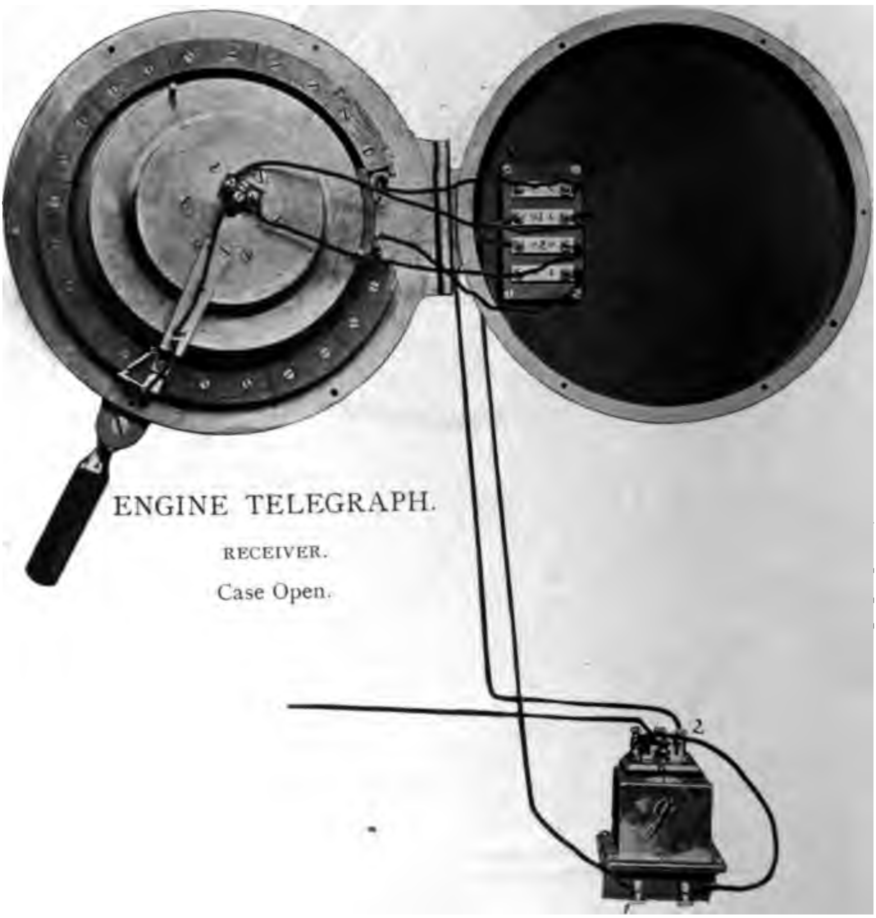


FIG. 17.

four knife contacts. By moving this switch in one direction, or the reverse, the connection is made or broken to both ends of the resistance wire $a\ b$ and both ends of the galvanometer wire. To get ready any transmitter for use, then, it is merely necessary to move its switch in the direction marked on the pedestal.

When any such transmitter is not in use, its switch must be moved to the "not in use" mark.

The covers of the transmitters and receivers are made to open on hinges, as shown in Figs. 15 and 17 respectively, so that the connections are readily accessible for examination. Before endeavoring to open the transmitter take off the handles.

The copper leading wires within the transmitters and receivers that are connected to the forward ends of the arcs of resistance wire are covered with yellow braiding; those connected to the after ends with green braiding; those to the galvanometers with green-yellow braiding; those to the bell contacts in the transmitter handles with red-yellow braiding, and those to the lamps with black braiding.

For engines whose speed ranges between 30 and 140 revolutions, the arms which carry the contacts that move over the resistance wires in both the transmitters and the receivers are so connected to the handles that, when the handles are at 85 revolutions ahead, the contacts are at the middle points of their respective arcs; and in constructing and installing the instruments the 85 revolutions mark is the place where the most care is taken to make the instruments balance exactly. The reason of this is that, since the resistance wires are never exactly uniform, the farther away the contacts get from the middle points, the more error is apt to creep in; and by making 85 revolutions as the middle point, the contacts do not get far away from it in either direction, even when going as fast as 140 revolutions, or as slow as 30; so that errors as great as ½ revolution are rarely found.

For engines whose maximum speed is greater than 140 revolutions, or less, the same rule applies, though the middle graduation will, of course, be some number greater than 85, or less.

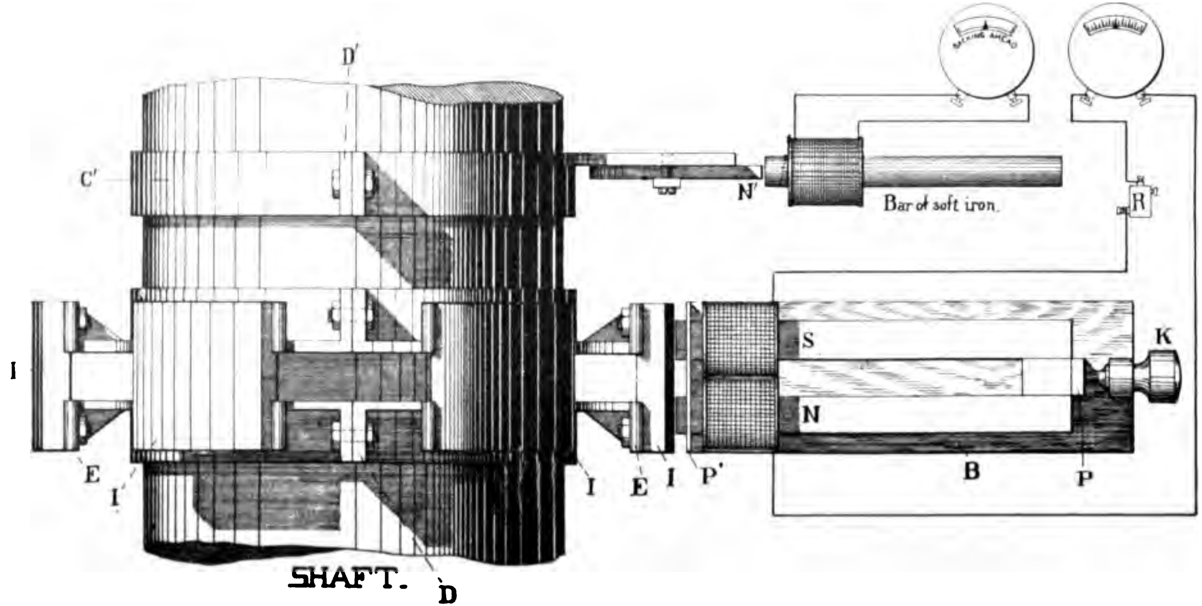
This engine telegraph was given a year's trial in sea service on board the U. S. S. New York. The test having been successfully passed, the apparatus has since been installed on board the U. S. S. battle-ships Indiana and Massachusetts. It is now being installed in the Texas, and is to be installed in the Brooklyn.

Weight of double transmitter complete, 140 lbs.

Weight of receiver complete, 80 lbs.

Diameter of face of transmitter or receiver, 14¾ inches.

FIG. 18.



LIEUTENANT FISKE'S SPEED AND DIRECTION INDICATOR.

The Speed and Direction Indicator.

The office of this apparatus is to indicate at a distance the speed and direction of revolution of the shaft of an engine, or any other shaft.

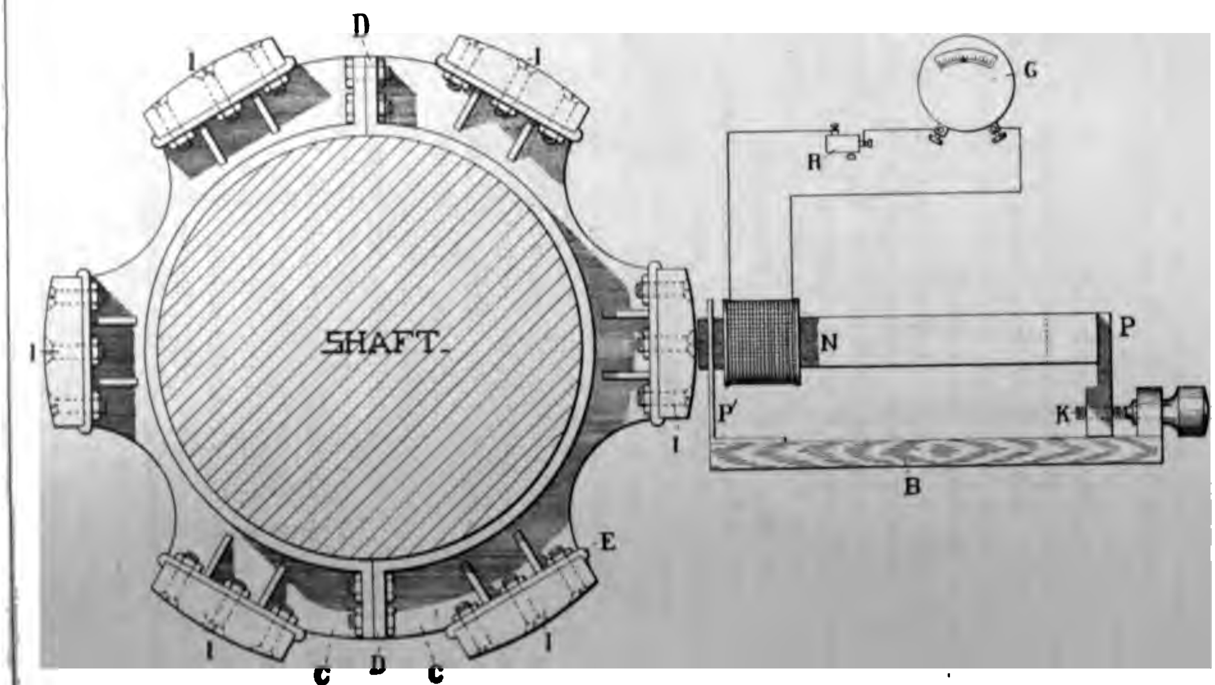
The underlying idea is an apparatus which is actuated by the shaft, but has no mechanical connection to it, which operates entirely by itself, and without intervention or care from any outside source; and which has no belting, or gearing subject to slipping, or to wearing out in service.

The speed indicator (direct reading) consists, broadly speaking, of an alternating current system, in which the alternating currents are induced by the rotation of the shaft, being great or small according as the shaft moves rapidly or slowly; and of an alternating current indicator, which indicates the magnitude of the current, and therefore the speed of revolution.

The direction indicator consists also of an alternating current system actuated by the motion of the shaft.

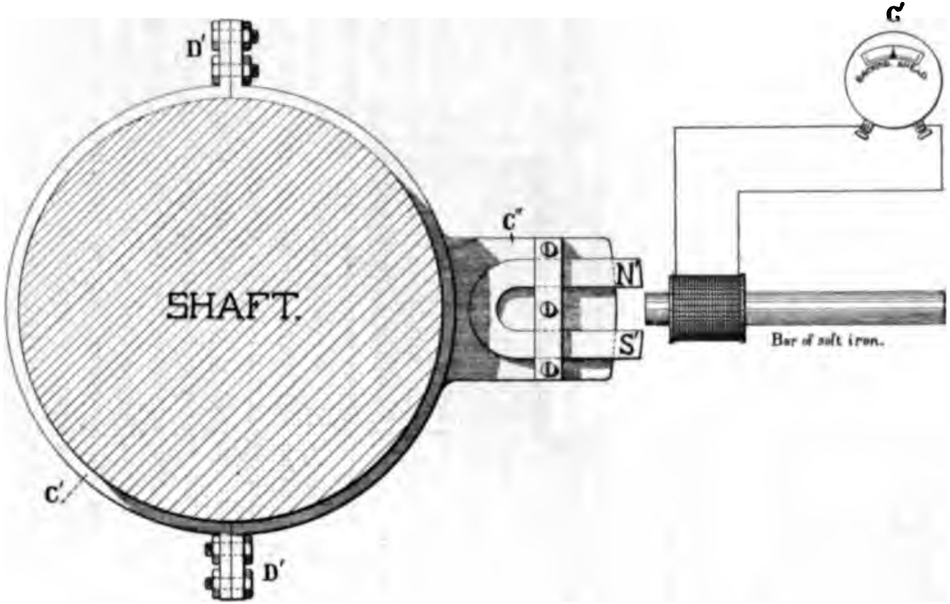
The apparatus is shown in Figs. 18, 19, 20, 21, and 22. Fig. 18 shows both circuits connected to their respective indicators. Mounted on the shaft are two rings, C and C'. Each ring is in halves, which fit the shaft, and these are clamped on, as shown, by lugs at D and D'. (See also Figs. 19 and 20, in which Fig. 19 shows the part pertaining to the speed indicator, and Fig. 20 shows the part pertaining to the direction indicator.) Secured on the ring D, or rather on a web that is cast on ring D, are, say, six soft iron inductors, I. These inductors, when revolved by the shaft, pass in front of the poles of the magnet S N. On the poles of the magnet S N are two coils of wire, and these are connected to the alternating current indicator G. When one of these inductors, I, is directly in front of the poles S N, the magnetic flux passing through the two coils is at its maximum. When no iron inductor is near the poles S N, the magnetic flux is at its minimum. As these iron inductors revolve before the poles, consequently the magnetic flux is increased and decreased as many times per revolution as there are inductors. Each increase and decrease of the magnetic flux produces an alternating current in the coils, according to principles well understood, and the more rapid the increase and decrease, the greater the electro-motive force induced. It is evident that, in manufacture,

FIG. 19.



] AND DIRECTION INDICATOR.

FIG. 20.



LIEUTENANT FISKE'S SPEED AND DIRECTION INDICATOR.

it is possible, with a proper construction of the apparatus and with a proper proportioning of the parts, to so control the inductance of the circuit, and to so arrange the inductors and the number of them, that the current in the circuit shall increase very considerably as the speed of the rotation of the shaft increases. In the drawings, the magnet S N is shown as a permanent magnet. Of course it can be an electro-magnet, if desired. If a permanent magnet, the steel must be specially hardened, in order that it may not lose its magnetic strength with age.

It is advisable, in the construction of the apparatus, to introduce an adjustment for controlling the air gap between the inductors I and the magnet poles N S, and, therefore, the magnetic flux and the strength of the current generated. The adjustment is accomplished by mounting the magnet S N on the two supports P and P′, Figs. 18 and 19. By turning the screw K in one direction or the other, the magnet poles are moved longitudinally in the stationary support P′, and moved closer to, or further from, the inductors, thus increasing or decreasing, at will, the strength of the currents generated. The usual distance is about $\frac{1}{16}$ inch. In installing the apparatus, it is merely necessary to adjust the distance until G indicates correctly.

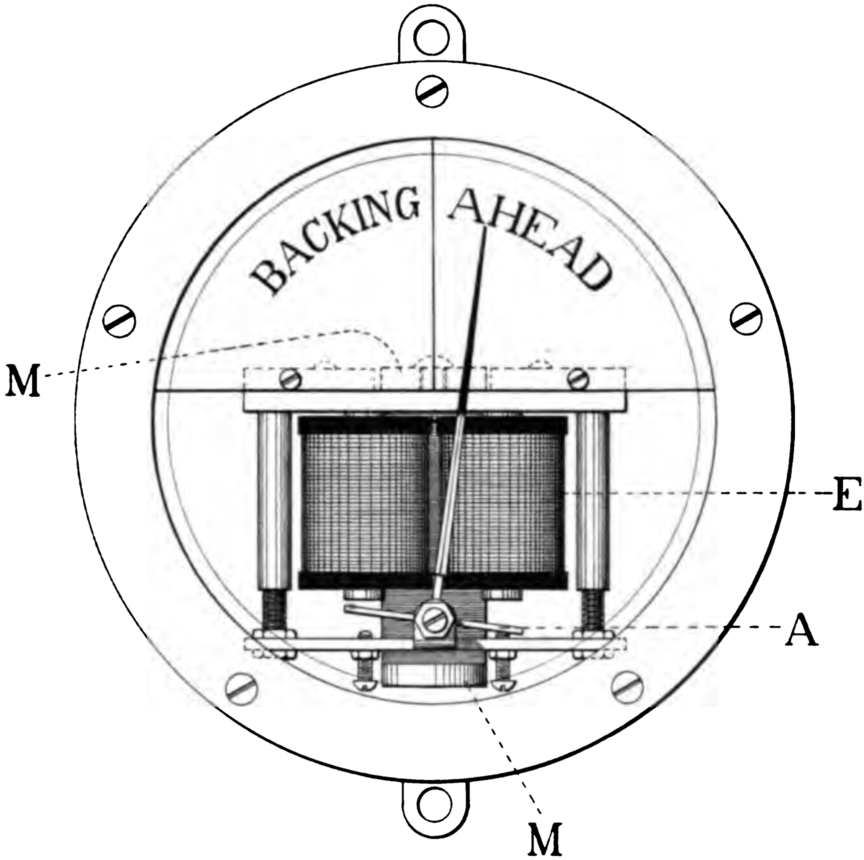
For making smaller adjustments, the rheostat box R may be mounted near the indicator G. This rheostat box is of the general type used in the range-indicator, and consists, broadly speaking, of a resistance wire wrapped around the surface of an insulating cylinder, so arranged that, by revolving the cylinder, a greater or less amount of resistance may be introduced in the circuit. This adjustment is not always used.

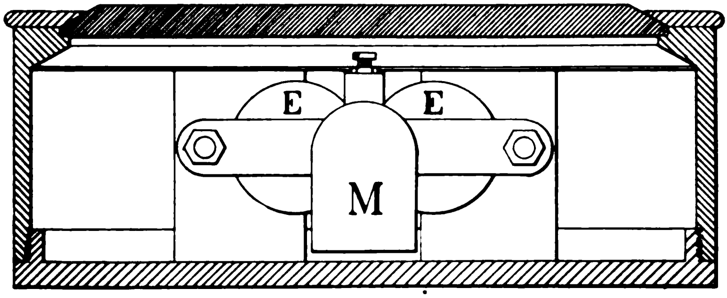
The graduations of the galvanometer G are made empirically in manufacture. A shaft carrying the inductors I is run at the various speeds, and the scale of the indicator G is marked with the proper numerals at the places at which the needle stands.

When the speed indicator is mounted on board ship the electrical apparatus of the indicator may be mounted in a water-tight case filled full of a liquid in order to steady the needle. Doubtless many different liquids may be used. Poppy-seed oil is satisfactory; but alcohol mixtures dissolve the shellac on the wire. The galvanometer case is filled from the top, by pouring the liquid through a sort of stand pipe P, Fig. 22, in which it stands at a height somewhat above the case itself. The filling hole

DIRECTION INDICATOR.

Fig. 21.





in the pipe is closed by a screw plug, and in this plug is a small hole, which allows the passage of air into or out of the pipe, as the liquid contracts with cold or expands with heat.

The alternating current galvanometer, which is ordinarily employed, is not very different from the direct current galvanometer shown in Fig. 6. But the permanent steel magnet is replaced by a stationary coil of wire which is in series with the movable coil or bobbin. Whenever the current changes in direction, it changes in direction in both the stationary and the moving coil, so that the direction in which the moving coil turns, due to mutual reaction between the two coils, is always the same. Two pairs of volute springs, similar to those in the direct current galvanometer, keep the moving coil, and therefore the needle, at a certain normal position of rest. But any current traversing the coils moves the coil against the springs through an angle which depends on the strength of the current.

That part of the apparatus which shows the direction of revolution is shown in Figs. 18, 20 and 21. The magnet N′ S′ is mounted on a projection, C″, secured to the band C′, which is secured on the shaft by means of lugs and screws D′. Mounted near the path traced by the poles N′ S′ in revolving, is a bar of soft iron, on which is a coil of wire connected to a direct current galvanometer, polarized relay, or other current indicator G′. in which a current in one direction causes the needle, or pointer, to move in a certain direction, while a contrary current causes it to move in the opposite direction. Suppose that the shaft is revolving in the direction of the hands of a watch, and that the pole S′ approaches the bar of soft iron until directly opposite to it. The approach of this pole will, of course, induce a current of a certain direction in the coil, which current will cause the needle, or pointer, to move, say, to the right, with a quick motion. As the shaft continues to revolve, the pole S′ leaves the bar of iron and the pole N′ comes up to it. This act induces in the coil a current opposite in direction to that induced by the approach of the south pole, and tends to give the needle, or pointer, a movement, say, to the left. The revolution of the shaft continuing, draws the N′ pole from the bar of iron, and this act induces another current in the coil in the same direction as did the approach of S′ pole, and, therefore, another movement of the needle, or pointer, say, to the right. The result is, there-

SPEED INDICATOR

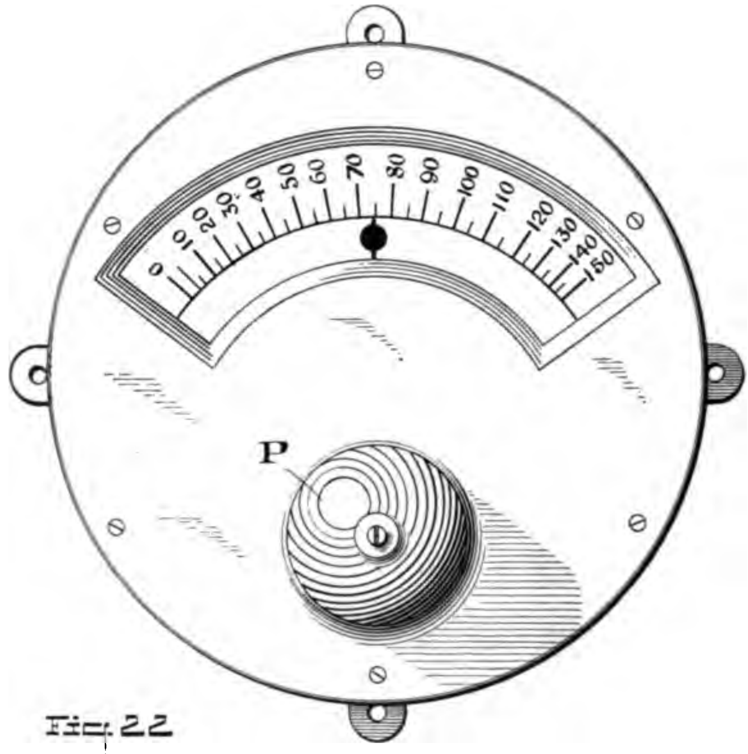
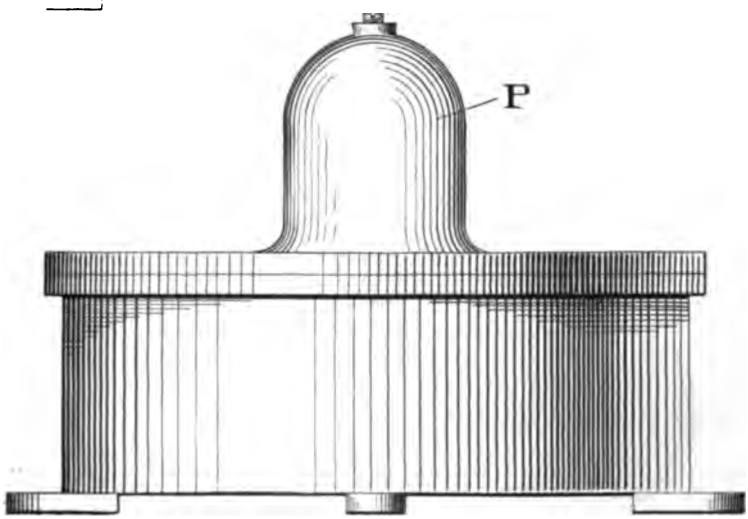


Fig. 22



fore, that at every revolution of the shaft in the direction of the hands of a watch, the needle, or pointer, of the indicator gives quick movements, say, to the right, left, right. If the shaft is moving in the reverse direction, the state of affairs produced is just the reverse of that above cited: so that at every revolution of the shaft, the needle or pointer of the indicator makes quick movements, say, to the left, right, left. By merely looking at this indicator, therefore, an observer sees at once in which direction the shaft is revolving, and he sees also when each revolution takes place. Not only this, but the observer, when he has leisure, can count for one minute the movements of the needle or pointer of G′ and see what was the number of revolutions actually made in the minute. The direction indicator is, therefore, a speed indicator also, and may be used as such in case of accident to the direct reading instrument, in connection with which it may always be employed, moreover, as a means of verification.

Fig. 21 shows a "polarized relay," such as is used for ringing magneto bells, adapted as a direction indicator. The armature A, po-

FIG. 22 A.

larized, (magnetized) by the permanent magnet, M, is pivoted between the two poles of the electro-magnet E. The alternating currents generated pass through the coils of this electro-magnet and tend to give the armature successive movements right, left, right, or left, right, left, at each revolution. And since there is no directing spring on the armature, and since the magnetized armature when moved to either side tends to remain there, by reason of its nearness to one iron core or the other of the electro-magnet E, the armature remains during the whole time of a revolution, except when the magnet N′ S′ is actually passing the soft iron bar and its coil, at the position in which it was placed by the last current. In other words, the armature has a certain position of rest which it occupies throughout nearly the whole of a revolution, and which is the position in which it is placed by the last current of the three which are induced by the passage of the magnet N′ S′ in front of the soft iron bar and its coil.

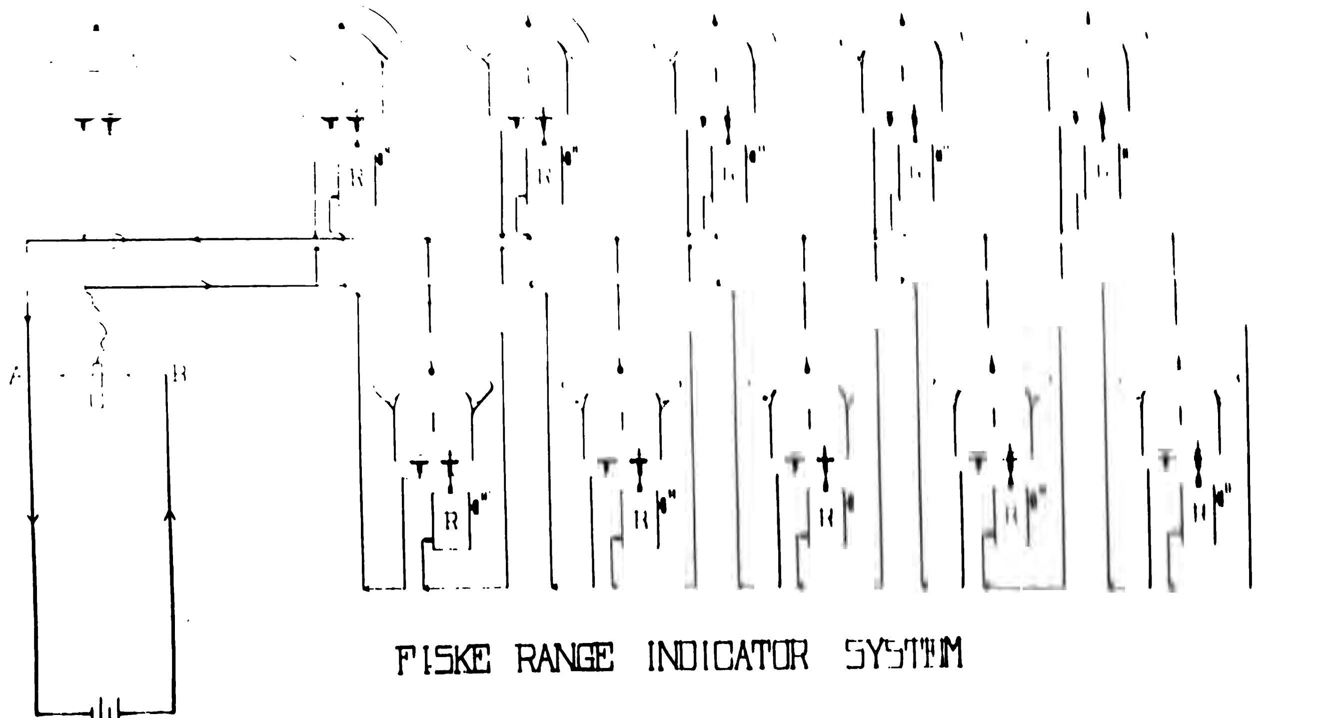
Furthermore, as the last current, when the shaft is going in one direction, is the reverse of what it is when the shaft is turning in the opposite direction, this position of rest is on one side or the other of its middle position, according as the shaft is going ahead or backing; and as the first current generated in any revolution is the same as was the last current, and as the armature cannot move any farther, the first motion cannot take place except during the first revolution of the shaft.

The result of all this is, that, if the shaft be going *ahead*, the pointer of the direction indicator, which is attached to the armature, will occupy a position of rest on one side of the scale and will make a quick motion to the left and back at each revolution; whereas, if the shaft is *backing*, the pointer will lie on the other side of the scale and will make a quick motion to the right and back at each revolution.

The two sides of the scale are marked "Ahead." and "Backing" respectively, as shown in Fig. 21.

The copper wires used in the circuits should not be less in size than No. 16 American gauge.

The speed indicator has been in successful operation on board the U. S. armored cruiser New York for about eleven months, and the direction indicator in the same ship for about six months. Both are now being installed in the battle-ship Texas, showing in the conning-tower the speed and direction of revo-



FISKE RANGE INDICATOR SYSTEM

FIG. 23.

lution of both engines; and they are to be installed in the Brooklyn.

Speed and Direction Indicator.—In case the permanent magnet of the speed indicator should in time lose so much of its magnetism as to need recharging, the recharging can be done by simply holding one pole against the pole of opposite name of a dynamo for, say, a minute, tapping the magnet smartly meanwhile, and then pulling it quickly away. In cases where more than one indicator of speed is desired for any shaft, it is safer to use a transmitter on the shaft for each indicator, in order that an accident to any indicator may not impair the efficiency of the others.

In the illustrations the magnet of the direction indicator is shown as projecting radially from the shaft. In many cases, however, it is more convenient to have the magnet lie parallel with the shaft or at an angle to it. The arrangement most convenient for installation and use must be the one used in each case; but the poles of the magnet should not be closer than two inches to the iron shaft.

The liquid for the speed indicator should be a thin vegetable oil which does not congeal readily. Poppy oil and oil of almonds are suitable, as they do not congeal until near 0° F.

For illuminating the scales of the speed and direction indicators, a small electric lamp is placed inside the direction indicator in such a position that it illuminates both scales. The light is turned on by pressing a water-tight push button on the back of the case.

Diameter of speed indicator = 7¼ inches.

Note.—The speed indicator works at its best when it is so placed that the half-way position of the needle is athwartships, and when the liquid is just thick enough to prevent the needle from vibrating when the propeller is racing. The direction indicator is important principally as a verification of the speed indicator, because it is so easy to change the adjustment of any transmitter in the engine-room, either from accident or for mischief. To open the direction indicator, unscrew the case.

Range Indicating System.

In the accompanying drawings, Fig. 23 is an electrical diagram illustrating the principle of the system, and showing one transmitting instrument T, and ten receiving instruments I, in circuit, each receiving instrument having an adjustable resistance in series with it, each adjustable resistance being in a metal box R. Fig. 24 shows in detail the mechanism by which in practice the contact C (Fig. 23) is moved along the resistance wire AB. Fig. 25 shows in detail the mechanism of the adjustable resistance inside of the box R; and Fig. 26 is a view of one of the receivers, or indicators, I (Fig. 23), with its resistance box R in position below it.

Referring first to Fig. 23, AB is part of a conducting circuit which includes the battery or other source of current, such as the electric light mains of a ship, connected through a suitable resistance, as shown in the cases of the helm indicator, steering telegraph and engine telegraph, in Figs. 1, 7, 10 and 11. T is a galvanometer which is connected in shunt with AB, one terminal being fixed at the point A, and the other terminal, or contact, C, being movable along the conductor AB. It will be clear that if the contact C is moved along the conductor AB, the difference of electric resistance, and, therefore, of electric potential or pressure between the points A and C will be varied; and consequently the extent of deflection of the needle or index of the galvanometer T may be controlled as desired, so as to cause said index to point to any scale-division or other mark or marks inscribed along its path. Connected in multiple arc with the galvanometer T are the two conductors + and —. Obviously these conductors will also be affected by the movement of the traveling contact C along the line AB, and will assume a difference in potential depending on the position of C on AB; so that if galvanometers I be connected to these conductors in the manner shown in Fig. 23, these galvanometers will respond to the movements of the contact C, for the same reason as does the galvanometer T. Furthermore, if all the galvanometers T and I be exactly similar, the needle deflections in all will be the same; and thus any indication caused in the galvanometer T will be repeated in the galvanometers I. Therefore, if T be the transmitting galvanometer, and if the instruments I be located at distant stations, it is plain that an operator at T, by adjusting the traveling contact C, can produce in his instrument a deflection which will instantly be repeated and shown at the distant stations in the receiving galvanometers I. It will be apparent, however, that if the galvanometers I are differently located with respect to each other and to the galvanometer T, so that in the circuit of one there is a different resistance from that which is in the circuit of the others; or if from any cause, such as rise in temperature, and consequent temporary loss of the magnet's strength, any galvanometer becomes less sensitive, means must be provided whereby said galvanometer may be adjusted or regulated so as to compensate for any such differences or changes, or, in other words, so that each receiving galvano-

meter may be so regulated that its deflections or indications will correspond to those of the transmitting galvanometer T. In the practical construction of the system these means are provided, and consist merely of an adjustable resistance placed in series with each galvanometer, and secured in a water-tight iron box R.

Turning now to Fig. 24, which shows in detail the means employed for moving the contact C along the wire AB, we see that the wire AB is wrapped in a spiral groove traced in an insulating cylinder D. The ends of the wire are secured to german silver springs, *g*, *g*, secured at the ends of the cylinder near the axis. The binding posts A and B are insulated from the metal box J, and their ends are prolonged about half an inch inside the box into cylindrical pins, or axles, *a*, *a*, which fit in the cylinder D, and press tight against the german silver springs, *g*, *g*, to which are secured the ends of the resistance wire AB. There is, therefore, a complete circuit from the binding post B to the german silver spring *g*, through the resistance wire that is wrapped around the cylinder, to the german silver spring *g* at the other end of the cylinder, and thence to the binding post A.

The cylinder is revolved on the axle AB by means of the handle H, which turns the screw S, and the gear wheel G, and thence the gear wheel G′, which is secured to the cylinder D.

The contact C is secured to a stout piece of rubber that is secured on a nut N, that travels on the screw S. The pitch of the screw S and that of the spiral on the cylinder D are equal, so that, if the handle H be turned, the contact C will move with the nut N, though insulated from it, and press successively on different parts of the wire. The contact C is connected by the flexible wire W to the binding post C′. If the battery be connected to the binding posts AB, and if A and C be connected to the binding posts + and — of T in Fig. 23, it is clear that the act of revolving H will cause the same effect as if the contact C were directly moved along the straight wire AB, in Fig. 23.

Turning now to Fig. 25, which represents the adjustable resistance in the box R, we see that the construction is nearly the same as that in the transmitting box just described. The resistance wire is, however, connected to the german silver spring

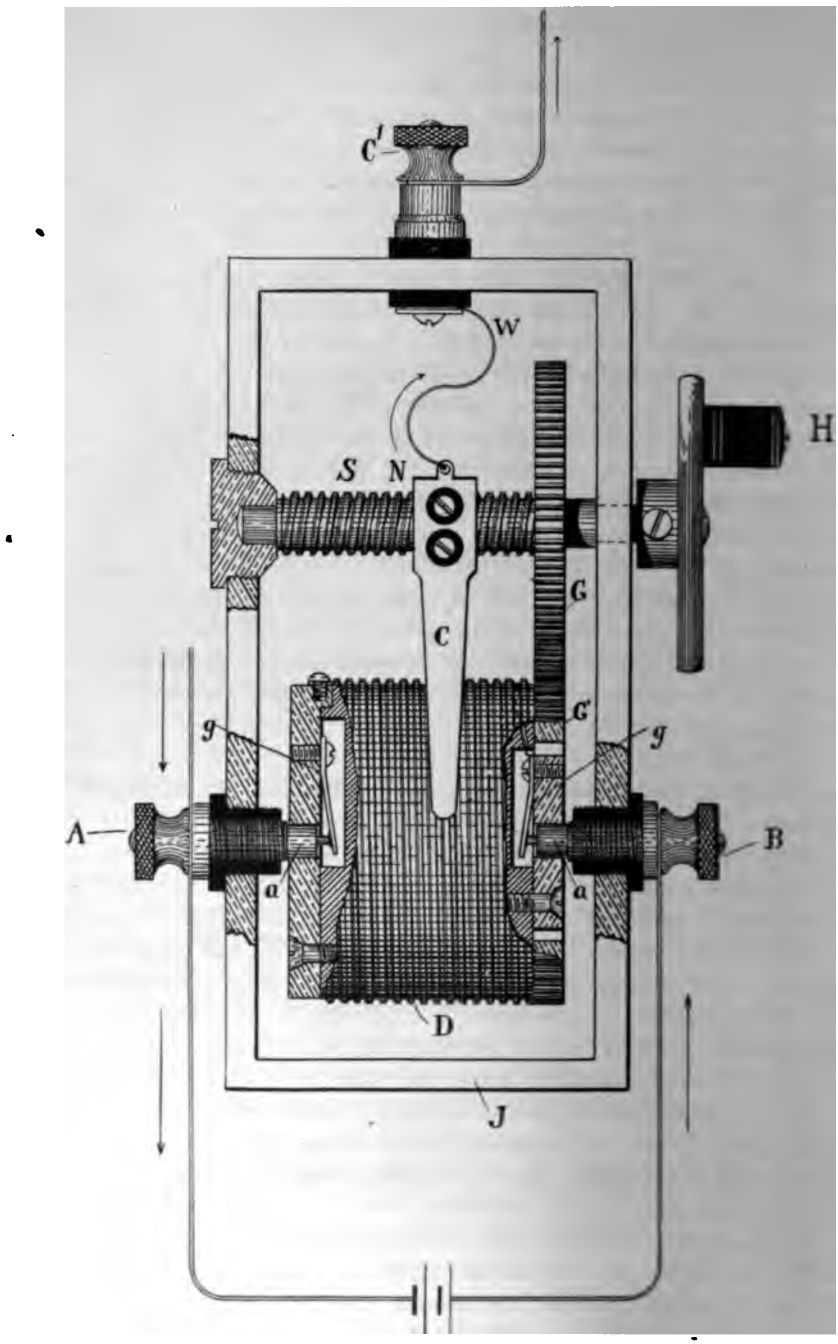


FIG. 24.

at the center of its cylinder at the left end only, as the right end of the wire is secured to the insulating cylinder at the point P. The contact C″ is moved in the same way as is C in the transmitting box, Fig. 24, and is connected by the flexible cord W′ to the binding post C‴. The current enters at the binding post A′, passes thence to the german silver spring at the left end of the cylinder, to the resistance wire wrapped on the cylinder, to the contact C″, and thence to the binding post C‴. Clearly, if this apparatus be placed in series with any galvanometer I, and the handle H′ be turned, the resistance in series with I will be varied and the deflection of I correspondingly changed.

The place for the transmitter T is near the reading instrument of the range-finder, so that any distance read from it can at once be made to appear on the transmitter and simultaneously on all the indicators in the ship.

To adjust the apparatus for use, connect the battery or other source of electricity and make the transmitter read, say, 2950, or any other preconcerted number. Then make each receiver read the same number, by turning the thumb wheel H′. The apparatus is now ready; but if there is time, it is best to try several preconcerted numbers in succession. It is better not to use the even hundreds in adjusting, because the graduations half-way between them are finer and give better opportunities for exactness.

The transmitting and indicating galvanometers are all similar, so that, in the event of accident to the transmitter, any receiver may be substituted for it. If this is done, however, it will be necessary, of course, to verify the adjustment of the instruments, in the manner above described.

In case a battery is used, the one found most satisfactory for all this class of work is the "chloride" storage battery. It is extremely uniform in resistance and in electro-motive force, and requires almost no care, provided it be connected to the electric light circuit and charged once a week. To do this is very easy, as it only takes a little more trouble than is required to turn on an incandescent electric light.

The galvanometers can be secured directly to a bulkhead. If desired, they can be graduated to work in a horizontal position.

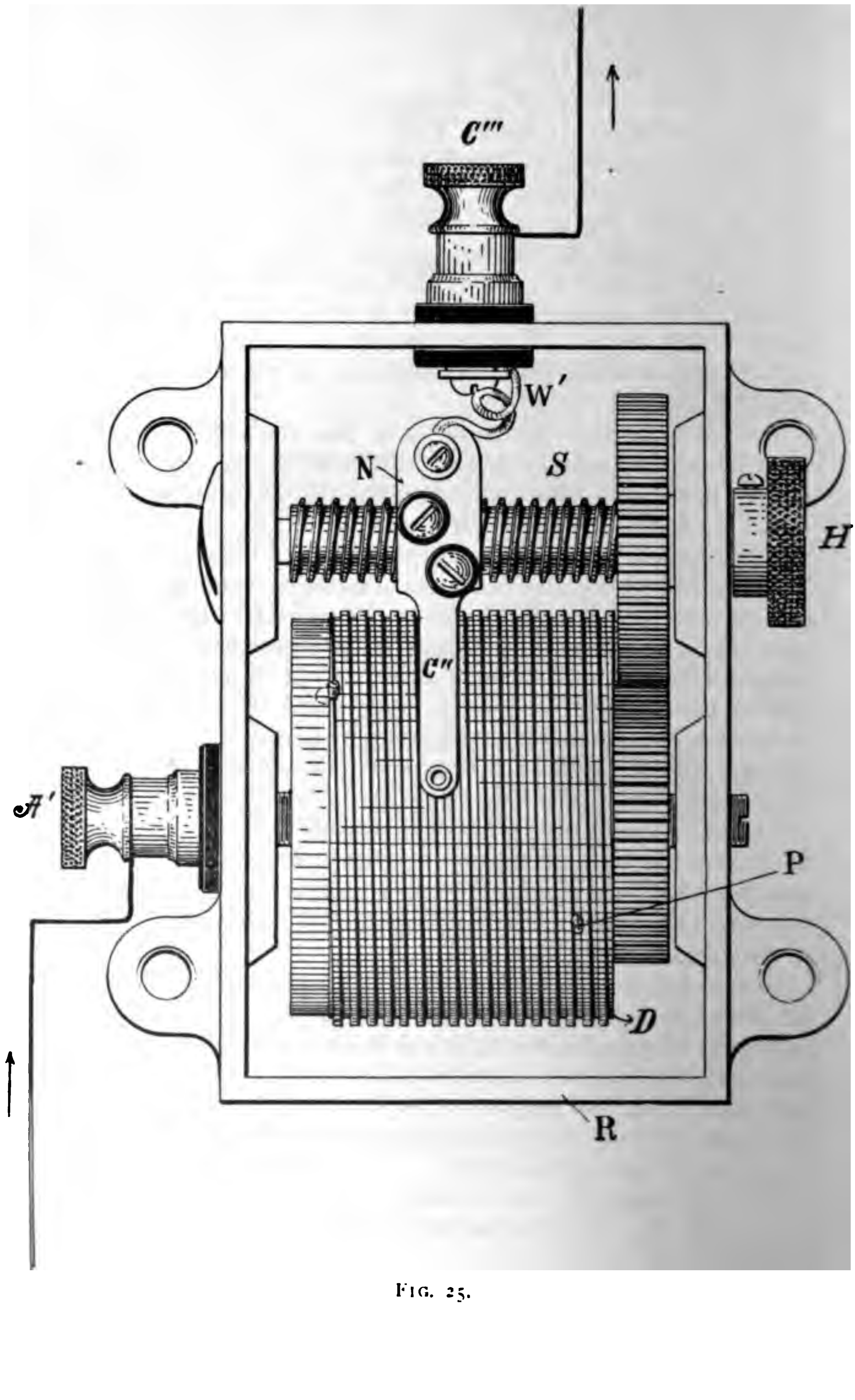


FIG. 25.

As far as giving accuracy of indications is concerned, the horizontal position is the best for a galvanometer, because the pivot of the needle is then vertical, so that the only friction possible is between the lower conical end of the pivot and the jewel in which it rests. From the circumstances of their use, the receivers must, as a rule, stand vertical; but there is no reason why the transmitters should not always be horizontal, both in service and when being graduated; and this is their proper position.

The later instruments are mounted in water-tight cases, and have the same construction as the instruments used in the helm indicator and steering-telegraph systems, illustrated in Figs. 6, 7 and 8.

Instead of being operated from a storage battery, as indicated in Fig. 23, the range-indicator circuit may be operated from the dynamo circuit, in the same manner as are the helm-indicator and steering-telegraph circuits; and the fact that the dynamo current is not uniform, but pulsating, is an advantage, because it gives the needles a minute vibration on their pivots, which is not sufficient to cause any difficulty in reading, but which prevents the needles from sticking.

The indicators should be so placed at the guns that they can easily be read by the gun captain, or other person charged with setting the sights, so that calling out by the voice will be avoided. A vertical position will, therefore, usually be best; and the indicators are graduated during manufacture while in that position. In case it is desired that one or more indicators shall lie horizontal, as may be the case in turrets, notice should be given in advance, in order that the indicators may be placed in that position during graduation. If the transmitter is placed below the protective deck, it should not, if it can be avoided, be put in a very hot place, because high heat diminishes temporarily the power of magnets, and this would render extra adjustment necessary on the transmitter.

The wires connecting the various instruments should have Navy standard insulation and be not less than No. 16 gauge. The mains should be laid, as far as possible, below the protective deck, with branches running up to each indicator, in order to minimize the chance of injury in battle.

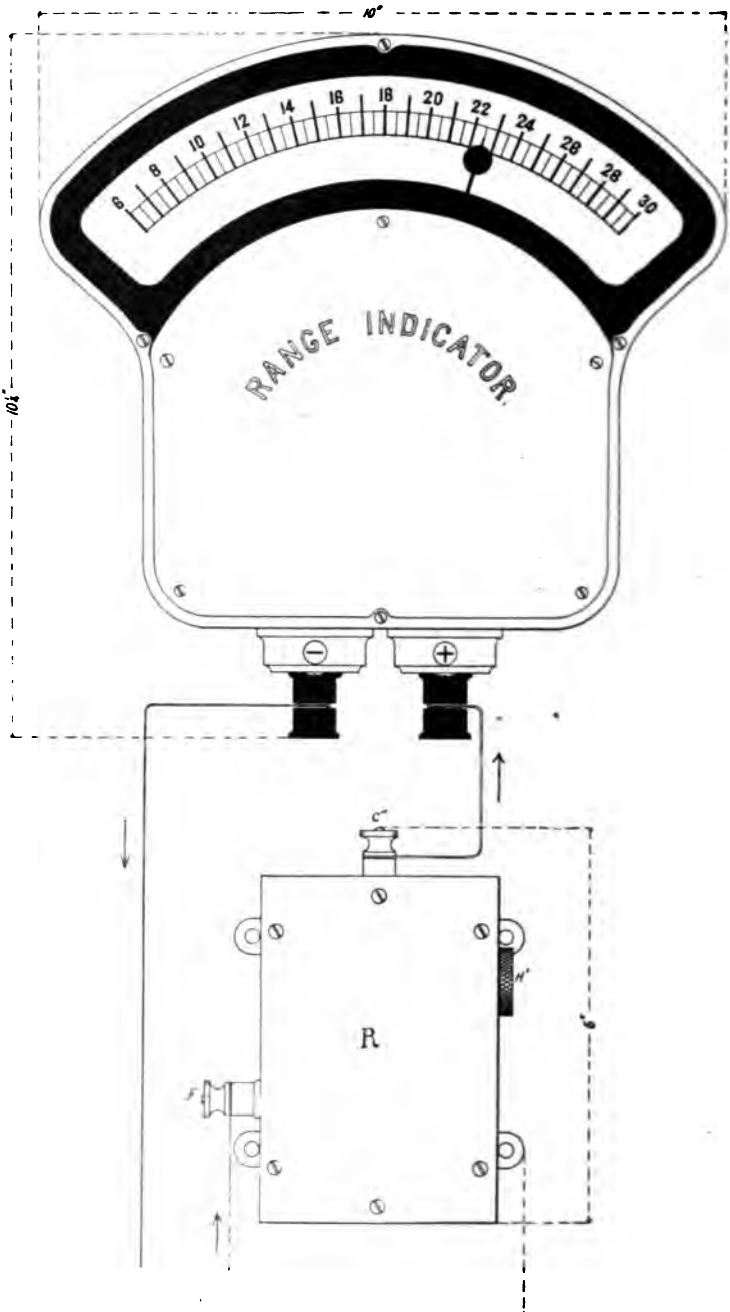


FIG. 26.

The rheostat which is placed in the dynamo circuit, for cutting down the current for the range indicators, should be of the Carpenter form, in order to economize space, and should, when the e. m. f. of the dynamo is 80 volts, measure about 50 ohms; so that, with the 3.7 ohms resistance of the transmitter coils the current in the coil will be about one and one-half ($1\frac{1}{2}$) amperes. The rheostat should be capable, therefore, of carrying $1\frac{1}{2}$ amperes without undue heating. It should be put in an accessible place in the dynamo room, where it can radiate heat readily, and for this reason should not be enclosed. Two separate wires are then to be run from the rheostat to the transmitter, so that the range indicator circuit will be independent of all parts of the lighting circuit, except in the dynamo itself.

The service trials held with instruments in the U. S. Flagship San Francisco for one year and subsequently in the U. S. S. Cincinnati for four months were satisfactory; and the system is now installed on a comprehensive scale in the battle-ships Maine, Texas, Indiana, Massachusetts, and Oregon, and is about to be installed in the armored cruiser Brooklyn and the battleship Iowa.

Resistance of each galvanometer, 60 ohms.

Weight of each galvanometer, 22 lbs.

Diameter of each galvanometer, 10 inches.

Resistance of each transmitter box about 3.7 ohms, the wire being 22 gauge.

Resistance of each receiving box about 17 ohms, the wire being 26 gauge.

Notes.—In the actual installation of the helm indicator and steering telegraph, each galvanometer of the helm indicator circuit is placed close to a galvanometer of the steering telegraph circuit; and both galvanometers are lighted from the electric light circuit and from the same rheostat, though in cases where the use of rheostats is inconvenient, small lamps using the full voltage of the light mains may be employed. In the case of the transmitter galvanometers of the steering telegraph and the receiving galvanometer of the helm indicator circuit, which are placed near them, the connections for their lights may be taken from the same rheostat as is used for the transmitters themselves, as shown in Figs. 7 and 8, the lights being connected to the binding posts *bc* and *cd* respectively.

The same arrangement may be used for connecting the range indicators to the electric-light mains of the ship, and for lighting them.

Regarding the external resistances for the helm indicator and engine telegraph circuits, which are preferably placed in series with the circuits, as shown in Figs. 1, 10 and 11, it is sometimes better to use two equal resistances instead of one for each circuit, one resistance being connected to the positive light main, and the other to the negative. The reason is that in many ships, the light mains are connected together through two lamps which are in series with each other, and the wire joining the two lamps is connected to ground, the arrangement forming a "ground detector." The two mains become thus forty volts above and forty volts below "ground" respectively (supposing the total voltage to be eighty). If, therefore, two equal rheostats are employed, the helm indicator and engine telegraph circuits themselves will never be more than about two volts from "ground," so that the chance of a "ground" in either circuit is extremely small. For the same reason it is better, in the case of the steering telegraph circuits, to connect the transmitters to binding posts *h f*, Figs. 7 and 8, which are about midway between the two ends of the rheostats and at nearly zero potential or "ground."

All of the ship telegraphs and their lamps can be run, if desired, direct from the electric-light mains of the ship without the introduction of any external resistance in their circuits, as it would be merely necessary to design them for the full voltage of the ship. But in view of the difficult conditions of ship life, especially in avoiding leaks and "grounds," it is thought that the low voltage system is the safest. The galvanometers may be made of convenient sizes for special installations.

If the radius of the wire of the transmitter of the helm indicator circuit is as great as 22 inches, the length of wire swept over by the traveling contact is sufficient to give the requisite deflection of the galvanometers, without using too great a current in the transmitter wire or too weak a spring in the galvanometers. It is safer, therefore, where the necessary space can be obtained, to use a radius not less than 22 inches.

Sticking of the Galvanometer Needles.—This is not likely where instruments are run from a dynamo current, because the fact that a dynamo current is not uniform, but pulsating, gives the needles a minute vibration, which shakes them on the pivots and antagonizes any tendency to settling at one position.

In case a galvanometer does stick, however, the sticking will be due probably to one of two causes: first, the needle may stick on its pivot; second, there may be a little dirt, specially iron filings, attracted by the magnet, between the moving bobbin and the poles of the magnet between which it moves. Either one of these contingencies is improbable, if the instruments have been carefully tested after installation and then closed tight. But in case the needle does stick, the second trouble is the more probable one. The best way to hunt for it is to take off the

cover of the instrument and hold an incandescent light so as to illuminate the interior, assisting the illumination by placing a sheet of white paper behind the moving coil. Any dirt can then be seen, and can be removed by a fine magnetized steel wire used as a probe. In case this annular space is clear, the difficulty will probably be in the pivot, and caused by the loosening of the little screws which adjust the pressure between the conical ends of the steel pivot and the agate bearings in which it rests at each end. The steel pivot ought to rest loosely, that is, not tightly, between its agate bearings; and the correct adjustment is made in manufacture and the adjusting screws are supposed to be set up tight, so as to prevent disadjustment. But in case the adjusting screws become loose, they must be reset. The only way is to tighten and loosen, carefully and by slow steps, until an adjustment is secured, such that the needle does not stick in any position.

Azimuth Telegraphs.

For telegraphing azimuths, or ranges varying between, say, 0 and 12,000 yards, for connecting position-finders to the gun, or relocator positions in forts, or for any other class of work in which many separate signals are required, the system is extended as indicated in Fig. 26, A. It simply amounts to using two transmitters and two receivers on separate circuits. One transmitter and its receiver are graduated in degrees, while the other transmitter and its receiver are graduated in minutes. Angles as high as 120 degrees can by this method be telegraphed with great quickness and extreme accuracy, that is, with errors of much less than one minute of arc.

For signaling ranges which must be correct within 1 yard, between 12,000 yards and 0, the same plan can be used, except that the 120 graduations of the left-hand galvanometer mean, not degrees, but hundreds of yards; while the divisions on the right-hand galvanometer mean, not minutes of arc, but single yards.

Besides the accuracy and quickness of this system of telegraphing, one important advantage is that the circuit is always closed, so that all the connections and contacts are always made, and there is no making and breaking of the circuit. All the connections may be made ten times as strong and big and firm as

is necessary, and even then they will not be very big, or take up much room; so that, if the system is kept in anything approaching good order, it will never break down in an emergency.

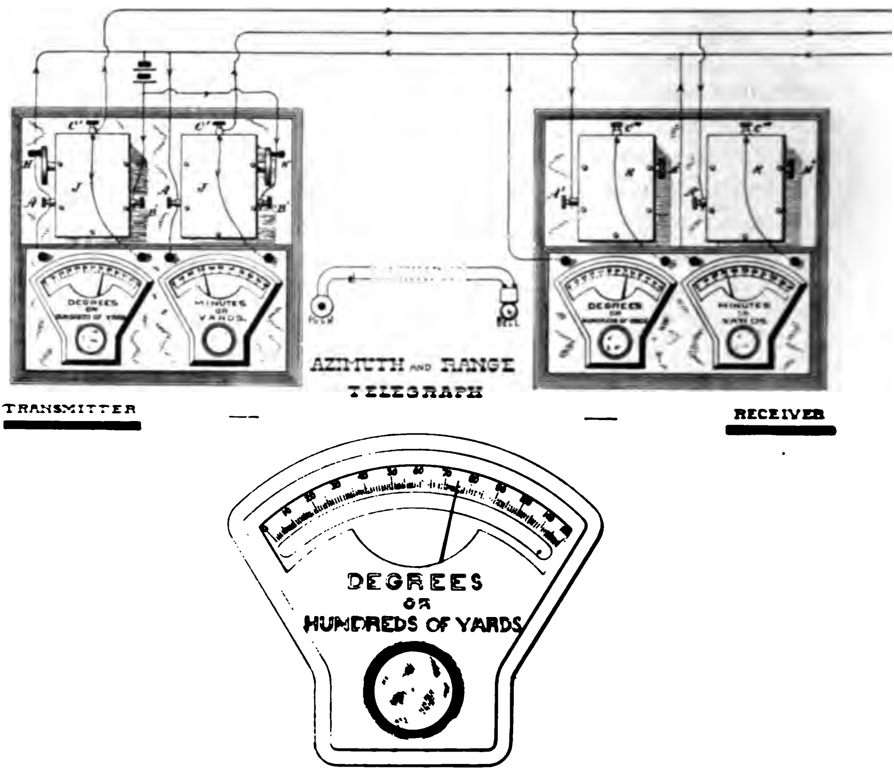


FIG. 26 A.

TRANSMITTER OF ORDERS.

The same system can be used to telegraph orders to the turrets, torpedo-positions, gun positions, and other parts of a ship, as it is merely necessary to graduate the dials of the indicators suitably, in some such way, for instance, as that shown in Fig. 26, B. The system is about to be tried in the U. S. armored cruiser Brooklyn, for transmitting battle orders from the conning-tower to the forward and after turrets, the dials indicating such orders as a captain would wish to give to the turrets in an action, when noise would make audible signals impossible.

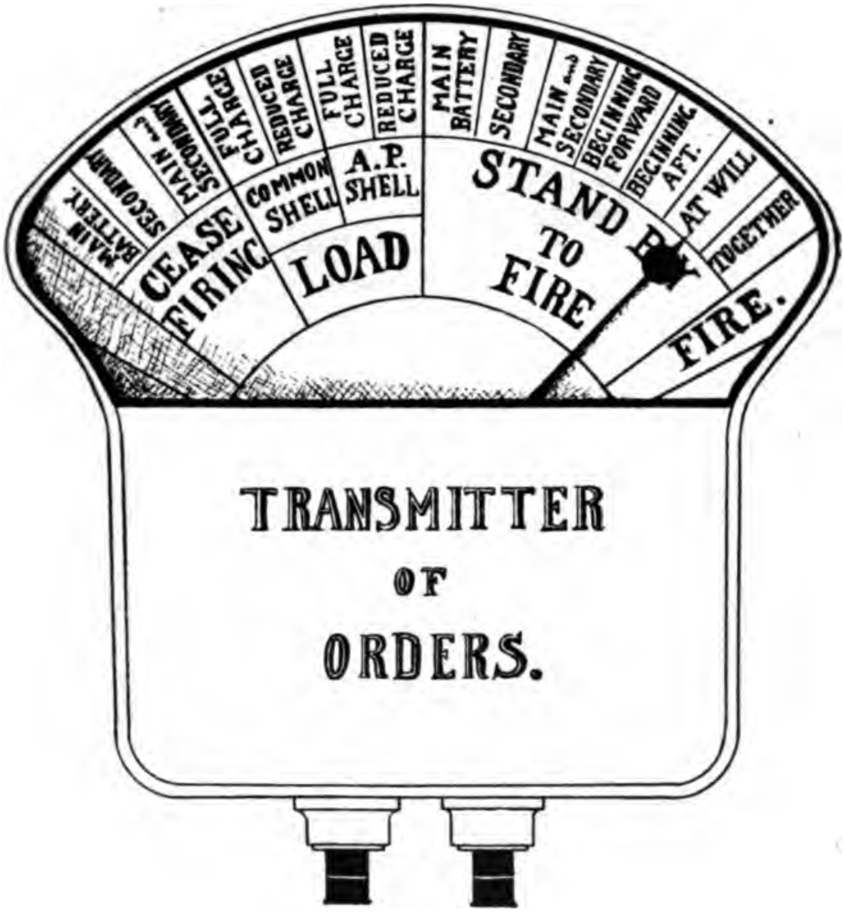


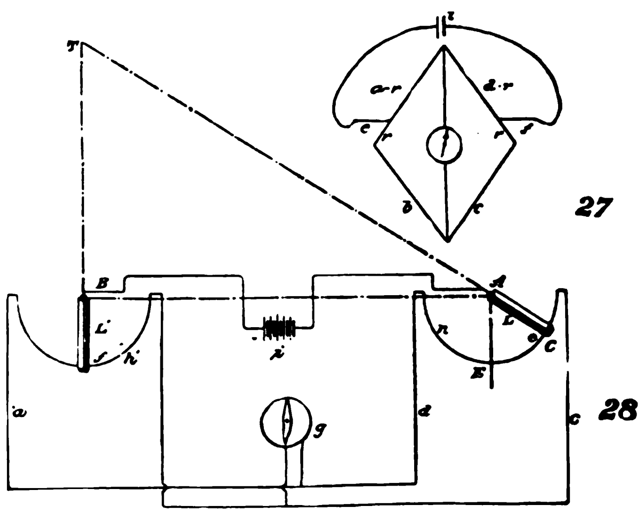
FIG. 26 B.

THE RANGE FINDER.

This instrument has now been tested for somewhat more than five years and has finally been adopted by the United States Navy. It has naturally undergone some changes during the process of evolution, and we now show the form which it has finally assumed. It will be remembered that the instrument is based, as far as the general principle goes, on the measurement

of resistances of a conductor, in the form of a Wheatstone bridge, there being two arcs of wire at the ends of a base line, each arc corresponding to two contiguous members of the bridge. Two telescopes are located at the ends of the base line and carry contacts which move over the wire as the telescopes are turned in angle, to be pointed upon any object.

Let Fig. 28 represent the arms *a* and *b* of a Wheatstone bridge bent into the form of an arc *h'*, while *c* and *d* are bent into the form of an arc *h*, both of these arcs being wires of conducting material. Let telescopes, pivoted at A and B, be fitted with the



FIGS. 27 AND 28.

contacts *e* and *f*. Now, if the extremities of the semicircular arcs are in the same line, the contacts carried by the telescopes will press on the middle parts of their respective arcs, and the galvanometer will, therefore, not deflect, whenever the telescopes are parallel and at right angles to the base line, because $ac = bd$. But when the telescopes are parallel they are directed at some point in space infinitely distant; that is, the distance of the object towards which the telescopes are directed is infinite. The position of rest of the galvanometer needle is therefore marked "Infinity."

Now, let the telescopes be directed at some point T not infi-

nitely distant. The telescopes will converge, and the angle of convergence is clearly the angle ATB, or the angle CAE, which is measured by the arc CE. In other words, the degree of convergence is measured by the difference in the positions of the contacts of the telescopes on their respective arcs. But, if the bridge was in balance when both contacts were at the middle points, it will clearly not be in balance when one is at the middle point of its arc and the other at C; and the amount by which it is out of balance will clearly vary with this difference of positions. That is, the greater the amount of convergence of the telescopes, the greater the deflection of the galvanometer; so that the deflection of the galvanometer varies with the angle ATB. By trigonometry,—

$$AT = \frac{AB}{\sin ATB} \times \sin ABT.$$

From this formula it is plain that, if ABT be a right angle, the distance AT varies inversely with the sine ATB; and it is, therefore, plain that, if the electro-motive force of the battery remains constant, the deflections of the galvanometer vary inversely with the distance; so that, if we know the length of base, we may graduate the galvanometer directly in units of distance, remembering that with such small angles as ATB always is in range-finding, the sine of the angle is practically the same as the arc.

But suppose that ABT is not a right angle. Suppose, first, that the target pointed at by the telescopes is infinitely distant, but in a direction inclined to the base. The contacts carried by the telescopes will not now press on the middle points of their arcs, but on points equally removed from the middle points. This is evidently the condition shown in Fig. 27, where the contacts have been moved away from the middle points over equal resistances. The galvanometer will not deflect, but will remain at its position of rest, which position on the galvanometer is marked "Infinity."

Let one contact be now moved from its position so that the telescopes converge and point at some object not infinitely distant. The galvanometer will deflect. In order to indicate the true distance of the object, the galvanometer must now deflect, not in proportion to sin ATB, but in proportion to ATB ÷ sin ABT. In other words, it must deflect more for an angle of

convergence ATB than if ABT were a right angle; and the smaller ABT is, the more the needle must deflect. In the range finder this increased movement of the needle is obtained by taking advantage of the curious fact that the current in the Wheatstone bridge increases as the contact points are moved away from the middle points. This is because the resistance

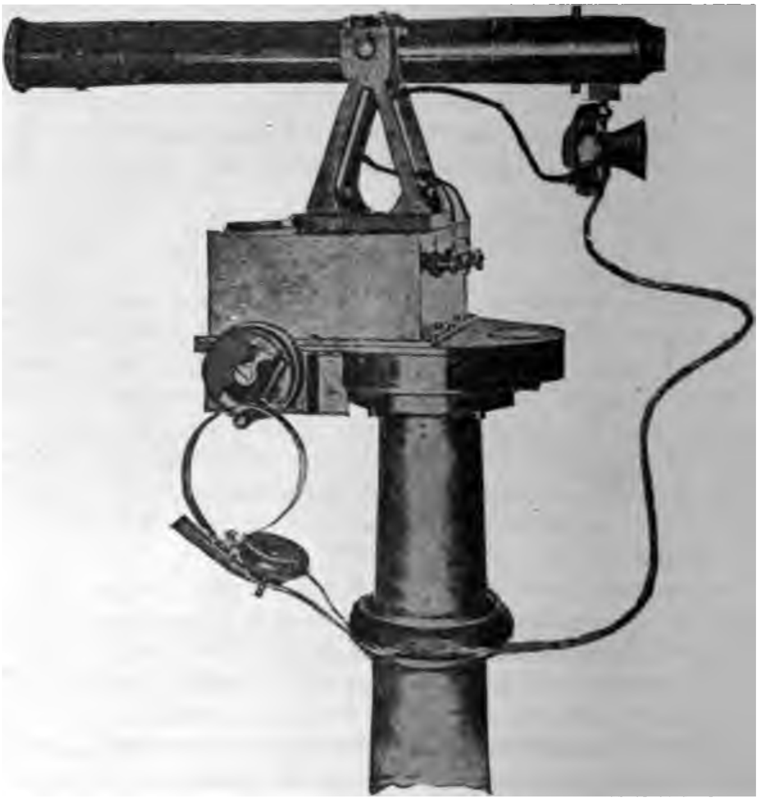


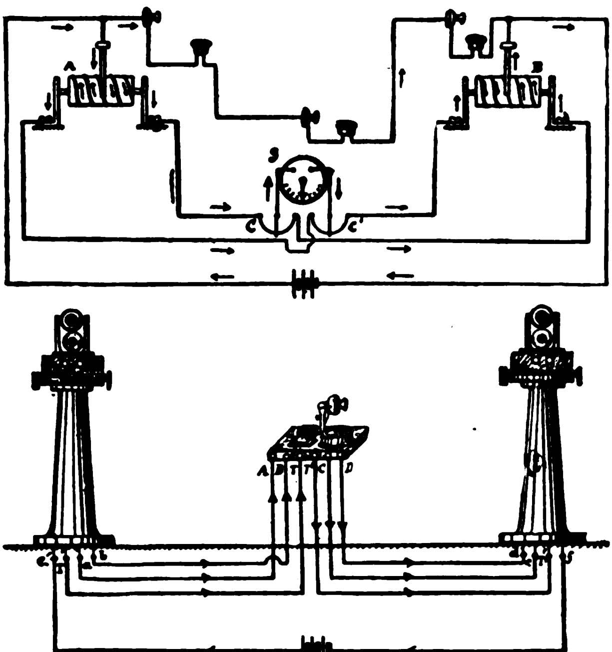
FIG. 29.

of the bridge is less; so that, if the electro-motive force of the battery is constant, the current increases proportionally as the resistance decreases.

In the apparatus as at present constructed, the wire is not laid in the form of an arc, but is wound upon a cylinder of insulating material. A contact presses on this wire, and as the telescope above shown in Fig. 29, is turned in azimuth, the insulating

cylinder revolves and causes the contact to press upon different parts of the wire. The special feature of value in this construction is that the wire is completely protected from the effects of weather, and, what is of more importance still, it makes it possible to use a device by which the non-uniformity of the wire is automatically corrected.

It has been said above that when the telescopes are parallel, and, therefore, pointing at some object infinitely distant, the contacts carried by the telescopes must press on the resistance



FIGS. 30 AND 31.—FISKE RANGE FINDER.

wires at similar points; so that the galvanometer needle will not move from the infinity mark no matter at what angle the telescopes are pointed. In order that this may be always the case, it is evident that we must have an exact equality in resistance per unit length of resistance wires, or else we must have some device by which non-uniformity will be corrected. This is accomplished in the instrument in question by a simple arrangement of the contact, by which, whenever the telescopes are

Fig. 32.

directed at similar angles, the contacts automatically go to such parts of the wire that the bridge is in balance and the galvanometer indicates infinity.

Another important feature introduced in the present apparatus is a temperature corrector, by means of which any change of temperature, either in the climatic or other conditions, and its consequent effect upon the resistance of the circuit, is automatically compensated. In Fig. 30 the temperature corrector is shown at C C' and consists simply of two similar arcs of wire introduced in the circuit betweeen the two observing instruments at the ends of the base line, upon which arcs press the contacts of the galvanometer G. In case the temperature of either instrument, say B, is raised and its resistance correspondingly raised, it is simply necessary to move the two contacts of the galvanometer G along the arc C C', a distance sufficient to compensate for the increased resistance of that instrument. In order to tell when this sufficient distance has been traversed it is merely necessary to set both instruments at similar angles and move the two contacts equally on C C' until the galvanometer shows infinity.

This operation requires a few seconds only, and suffices to adjust the range finder for the temperature conditions which prevail that day. Fig. 31 shows a diagram of the circuit of the range finder. The two instruments at the opposite ends of the base line with their telescopes and telephones are shown. The arcs *a* and *b* of one instrument are connected to the arcs *c* and *d* of the other instrument, through the temperature corrector, which is mounted on the base of the reading instrument shown in the center. The telephones on the two observing instruments are connected together through the telephones on the reading instrument, and the battery contacts are connected to the storage battery, shown below, which is ordinarily in the dynamo room of the ship. On the same base with the temperature corrector is the galvanometer or reading instrument. The captain of the range-finder crew is stationed in the conning-tower of the vessel or below the protective deck at the reading instrument and has all the devices for correcting the range finder under his hand. He has simply to see what figure the needle of the galvanometer points at and telegraph this figure to the guns, by means of the electric range indicator.

The details of the reading instrument are shown in Fig. 32; and the interior of the galvanometer, which is the principal part of the reading instrument, is represented in Fig. 33.

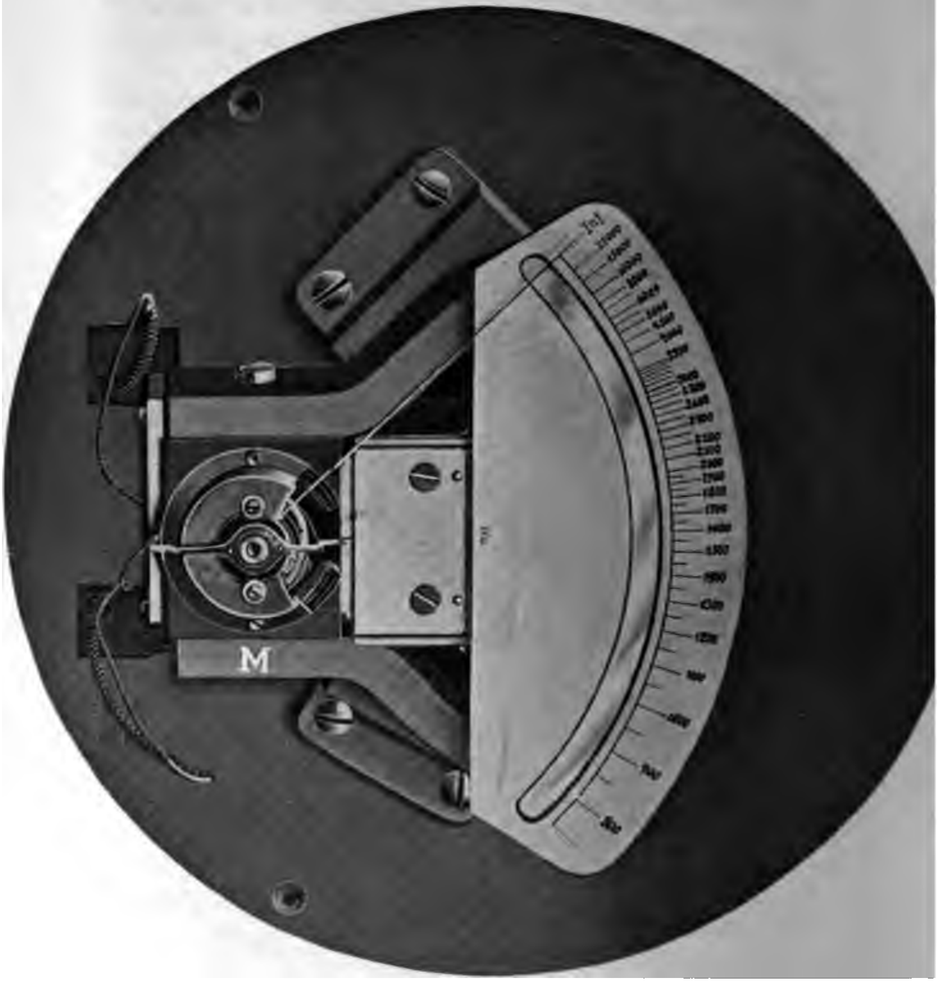


FIG. 33.

The shortest base lines with which this range finder has as yet been used successfully in practice, are in the New York and Indiana, in which the base lines are 46 and 44 yards respectively. In the Indiana, Massachusetts, Oregon, and Texas, the forward

observing instruments are mounted on a platform on the fore-mast, while the after instruments are at the after end of the superstructure. In the New York, both the observing instruments are on platforms on the masts; as is also the case in the Maine. In the other ships the observing instruments are usually secured on platforms built up from the deck, and on the conning-towers or pilot-houses. In most ships, the reading instrument and the transmitter of the range indicator circuit are in the c(ning-tower; but in the Maine they are below the protective c, which seems a better arrangement in a military sense. It w(ld seem advantageous also to protect the observing instru- n its to at least as great an extent as the rapid fire guns. The e e error, under conditions of service, with base lines of 45 yards, is about 1 per cent. for distances of 1000 yards, 2 per t. for distances of 2000 yards, 3 per cent. for 3000 yards, etc.

THE ELECTRIC TELESCOPE SIGHT.

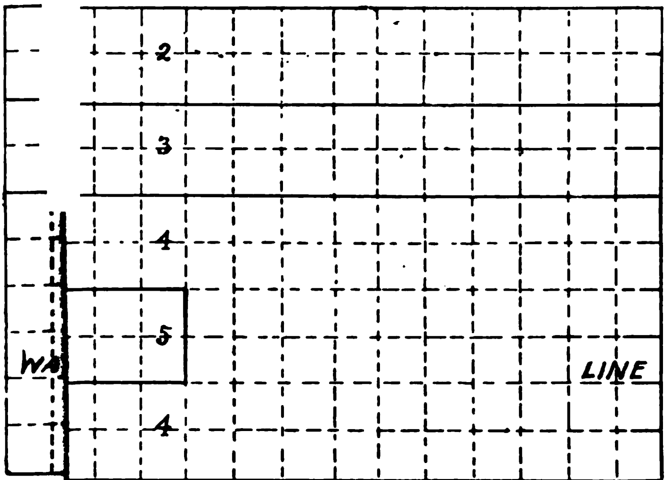
At 2000 yards, a ship of twenty feet freeboard subtends a tical angle of less than one-fifth (⅕) of a degree. The dis- : at which a gun captain stands behind his sights may be to be about 120 inches from the front sight and 60 inches m the rear sight; so that this angle of ⅕ degree is represented the front sight by about ⅖ of an inch, and on the rear sight about ⅕ of an inch. Now, in order to shoot correctly, the in captain must fire so that the projectile will leave the gun ju en the exact points of the two sights are in line with the ta :t. It is not very easy to do this, as the records of gun practice at sea most sorrowfully prove.

A little reflection will show why correct firing is so difficult. In the first place, the construction of the ordinary bar sights is such that, unless the sights are on a level with the target in a vertical plane, it is extremely difficult to tell if they are pointed in the proper direction in a horizontal plane; and not only this, but when the ship is rolling away from the target, the rear sight and the gun itself mask the target completely; in the second place, the line of sight sweeps over the entire vertical target in ⅕ of a second (supposing that the ship is rolling 1° per second, which is very slowly), so that the gun captain has only one-fifth (⅕) of a second of time in which to make up his

mind whether the sights are on the target, and to fire if they are on the target. Now the three objects which he is trying to get into line are the target, the front sight and the rear sight, of which one is 2000 yards distant, another about ten (10) feet, and the other about five (5) feet; so that he is called upon instantly to focus his eye on three points at distances of 2000 yards, 10 feet and 5 feet, and the human eye is so constructed as to make this impossible. But the formidable difficulty is that, during the one-fifth ($\frac{1}{5}$) of a second in which the gun captain must do the things above enumerated, he must, in addition, have the pupil of his eye behind the rear sight in an exact line with the line prolonged from the front sight to the rear sight. If the pupil of his eye is not exactly on this line he cannot recognize the instant to fire, except approximately, and if his eye be as much as $\frac{3}{8}$ of an inch above or below the line, and he fires when his front or his rear sight rests on the target, his gun will really be pointing 20 feet above or below the point of the target on which the sight rests. It is not an answer to point out the wonderfully fine shooting done by some men, because the records of target practice show that such shooting is, to say the least, exceptional. Now, a telescope of large field and small magnification has been found to practically eliminate all the errors of sighting, and to make it possible and easy for an ordinary man, with hardly any practice at all, to shoot fairly well always, and badly never, as was proved before an official board in the U. S. S. San Francisco, by the writer using in many cases absolutely untrained men, including firemen and coal-heavers. The result of the firing was plotted in the regular way, and is shown on plates A and B.

The large clear field of view with the two cross-wires, one vertical and the other horizontal, lets a gun captain see (even when the horizontal wire is far below or above the target) just how much the gun must be moved to the right or left; everything is exactly in focus, so that there is no strain on the eye whatever, and (which is the most important), the gun captain cannot sight wrong even if he tries. He cannot take a fine sight, or a coarse sight, or a bad sight. The cross-hairs are either plainly on the target, or plainly not on the target; and just so long as he looks through the telescope at all, he can see the cross-hairs in only one place, and that is in the fixed axis

Fi



at, E. Packard, C. Q. M.

from the ship, was so small in each case that it could not be

meas

SH
FI

F PRACTICE : May 7, 1894.

OF PRACTICE : Pearl Cay Lagoon, Nicaragua.

I
II

AND WEATHER : Fine light breeze at right angles to line of fire.

19 : Not troublesome.

G AND PITCHING : Rolling 1° each side, pitching very slight.

To prevent his firing when the indicators indicate differently, the firing circuit is broken at two places—one place being his firing key and the other place being a similar key near the elevator man. The gun cannot be fired unless both the elevator man and the gun-firer press their keys; and neither presses his key

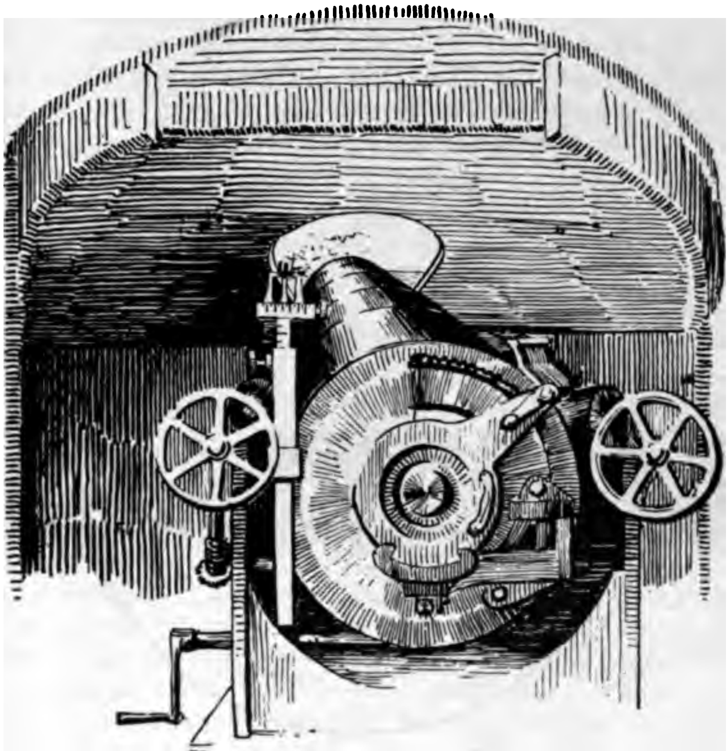


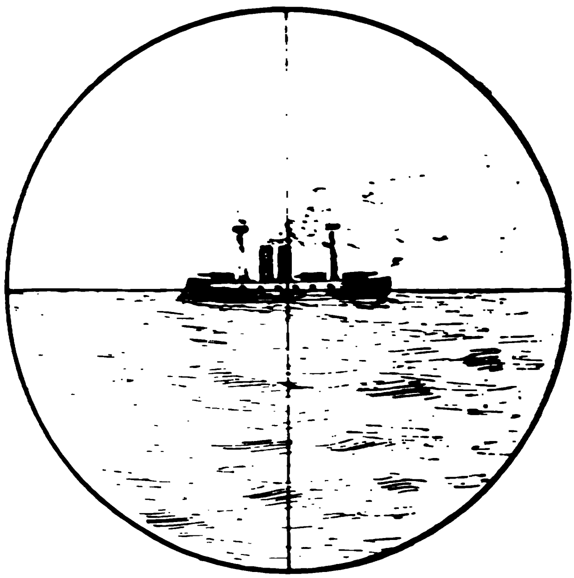
FIG. 35.—A BATTLE-SHIP 300 FEET LONG, MASTS 150 FEET HIGH, SEEN OVER ORDINARY GUN SIGHT AND THROUGH PORT IN GUN SHIELD.

Horizontal field in gun port=9.5°. Vertical field=3°. Eye of gun captain being 60 inches behind rear sight. Ship is 2,000 yards distant.

unless he is ready. The elevator man keeps pressing his key so long as the two indicators indicate the same thing; but, if the range suddenly changes, he releases his pressure on the key until by moving the elevator wheel he has made the gun elevation indicator indicate the correct distance; he does the same thing, if the gun-firer changes the position of his telescope and the indi-

[illegible] indicator. It will be noticed that [illegible] the part of the elevator man is a very simple [illegible] has to move his wheel a fraction of a revo[illegible] the other, to keep the needle of his indi[illegible] the same mark as is the needle of the range indicator beside it.

[illegible] of the telescope sight are arrangements for cor[illegible] and drift. The electric sight has not yet been [illegible] but it is merely a combination of the mechan[illegible] sight with a simplified form of the helm indicator [illegible] telegraph.



[illegible] SAME DISTANCE, THROUGH [illegible]

[illegible] Magnification, 4 diameters

[illegible] TELESCOPE SIGHT.

[illegible] the line of fire, especially [illegible] sight is attached directly [illegible] moves laterally and vertically [illegible]

[illegible] the telescope sight which [illegible] of a rapid-fire gun on board

the Yorktown in 1892, and afterwards in the U. S. S. San Francisco in 1893 and 1894, the gun being frequently fired in both ships to test the sight. Fig. 35 shows, in comparison and on the same scale, the field of view obtained looking through the port in the gun shield, when using the ordinary sights on a 6-inch gun, in the Yorktown, on the shield of which the sight was first tested.

Position Finders.

While the appliances of modern warfare conspire to remove practical naval gunnery from the realms of chance to those of certainty, the art of coast defense is keeping pace, and is replying with every kind of thinkable device for increasing the rapidity and precision of fire of forts, *i. e.* for sinking attacking ships. Secured on firm emplacements, behind impenetrable walls, the guns and mortars of modern fortresses present the highest example of the combination of tremendous strength with refined precision. For the large calibers, the use of disappearing guns is on the increase, the gun disappearing behind the parapet after firing, to get a new charge. In order that the gun may be exposed above the parapet as short a time as possible, it is elevated on its carriage in accordance with the range signaled, and is trained in azimuth, according to the direction signaled, before it is raised to fire, so that as soon as it is raised it can be immediately fired, and then by the energy of the recoil forced back at once to the loading position. Now, the determining of this range and direction is the office of a position finder. The simplest kind is the "depression position finder." Of this type there are a very great number on instruments in use in Europe, the most successful being that of Colonel Watkin, of which the English Government keeps the details a secret. In this country, that of Lieut. I. N. Lewis, United States Artillery, has proved extremely successful. It is not electric, however, and so a description would hardly belong here. The writer has endeavored to accomplish both the work of measuring and of signaling the results in instruments of this class by means similar to those employed in the range finder, in the manner hereinafter shown.

It may be pointed out here that if the position finder simply finds the distance and direction of the target from the position finder at a given instant, the people at the guns will not be

benefited much, for two reasons: first, by the time that the gun can be gotten ready in accordance with any range and direction signaled, the range and direction will have changed; second, the people at the guns want to know the distance and direction of the target from their guns and not from the position finder. To remedy the first difficulty the people at the position finder do not signal to the guns what the range and direction are at that instant, but they predict what they will be thirty seconds later, so that the gun people have thirty seconds in which to lay the gun. To enable the position-finder people to predict they take observations every twenty seconds, plot the exact position of the target each time on the plotting table of the position finder, and connect the various points by a line, more or less broken. A little practice enables them to thus lay down on the chart the exact track a ship is making. If the track shows that the ship has gone a certain distance in a certain direction in a certain time, it is not hard to prolong the track line so as to show where she will be two minutes later; in other words, to "predict her position." It is this predicted position that is signaled to the guns. When the ship arrives at or sufficiently near the predicted position, the signal is sent to the guns to fire. Of course if during the interval the ship suddenly changes her course and speed very greatly, she will not reach the predicted position at exactly the end of two minutes. But a heavy ship cannot alter her course and speed so much in two minutes as to throw out the predicted position much, as even a rough calculation will show, especially if she is in company with other ships in a channel; and even if she could, it would be simply necessary to hold the fire until a new position were determined, which would be a matter of a few seconds only. The manner of using the position finder can be best shown by an extract from the official report on one placed at Spezia, Italy.

The disposition of the Fiske position finder renders it possible to make rapidly a series of observations upon a target in motion, and to solve the problem of how she is going; to determine the route, the radius of the circle of turning, the speed, etc. During the recent trial at Spezia, the base line of the position finder being 104 meters long, there was determined the velocity of a torpedo-boat which was going at a speed of 8 knots, of 10 knots, of 12 knots, maintaining a distance from the position finder ranging from 2000 meters to 5000 meters. There was determined at regular intervals the different points of her track, and the

resulting speed deduced varied from the speed obtained on board the vessel itself by only 3 per cent. In order to give an idea of the quickness with which it is possible to fix the ship's position, and after the observers have had a certain amount of practice, it is sufficient to cite the fact that while the torpedo-boat was making a complete circle of 250 meters diameter at a speed of 10.5 knots, the average distance from the position finder being 1500 meters, there were plotted 11 successive positions. In another trial, while the boat was making a circle of 350 meters diameter, at a distance of 2500 meters from the position finder, at the same speed her position was plotted 17 times.

The position finder having determined the range and direction of the target from itself, it remains for the people at each gun to determine what are the range and direction from that gun. This may be done by means of tables of figures, which show for each gun what are the directions and ranges from that gun of every position that can be signaled from the position finder. But a speedier plan is offered by the instrument invented by Lieutenant Rafferty, United States Artillery, called a "relocator," in which the conversion from one system of co-ordinates to the other is done mechanically. The instrument is extremely simple in construction, and (which is more important) is simple in operation, but not being electrical, its description hardly belongs here.

Depression Position Finder.

When the ground in the vicinity of the water is high, the distance of a vessel on the water can be found very simply by mounting a telescope on an eminence, pointing it at the vessel's water line, and noting the angle of depression of the telescope below the horizontal. The height being known, the distance is inversely proportional to the sine of this angle, so that the instrument may be graduated at once in yards. The direction is obtained with equal simplicity, by noting the azimuth of the telescope, as shown on a horizontal circle. To make these measurements and send them to the guns automatically is the office of the instrument hereinafter described. Corrections are, of course, needed for the rise and fall of the tide and for changes in refraction. The special limitation of this class of apparatus is the fact that the smoke of guns frequently hides a vessel's water line altogether, as was conspicuously shown at the battle of the Yalu.

The apparatus consists in two principal parts, namely, a device for determining the distance and a device for determining the direction or bearing of the object. The said two parts are used conjointly, and thereby the location of the object may be recognized upon a chart representing the area of the harbor, for example, drawn on a reduced scale.

In the accompanying drawings, Fig. 38 is a diagram illustrating the operation of the distance or range finder. Fig. 37 is a diagram illustrating the operation both of the range finder and of that part of the apparatus which shows the bearing of the distant object. Fig. 39 is a side elevation of the observer's instrument and shows the mechanism thereof on a larger scale and in detail.

Similar letters of reference indicate like parts.

Referring first to Fig. 38, A is a telescope, sight bar, or other like means of directing the line of sight, indicated by the dotted line upon the object B. This telescope is to be located upon an elevation adjacent to the waterway to be protected. The telescope is pivoted at its outer end, so that it can be depressed through any desired angle in order to bring it to bear upon the object. The telescope is provided near its sight end with a contact piece or wiper which always bears upon a body of conducting material, represented symbolically at C. Connected with the ends of the body C is a voltaic battery, D, and connected in circuit with one end, E, of the body, C, and with the movable wiper or contact piece carried by the telescope A is a galvanometer, F. It will be apparent that as the telescope A is moved on its pivot its contact piece or wiper will be carried along the body C, and, as a consequence, a greater or less amount of the body C will be brought into the circuit which includes the galvanometer F. Inasmuch as the body C is to be constructed of, for example, a wire of uniform resistance per unit of length, it is obvious that as the telescope A is moved and a greater or less length of said wire is brought into the galvanometer circuit, the resistance thus interposed in said circuit will be increased or diminished; and as this length, and hence this resistance, depend upon the angle of depression of the telescope, it becomes a function of the angle of depression; and, equally, the deflection of the galvanometer F, due to this change, is also a function of the angle of depression. Therefore, knowing the

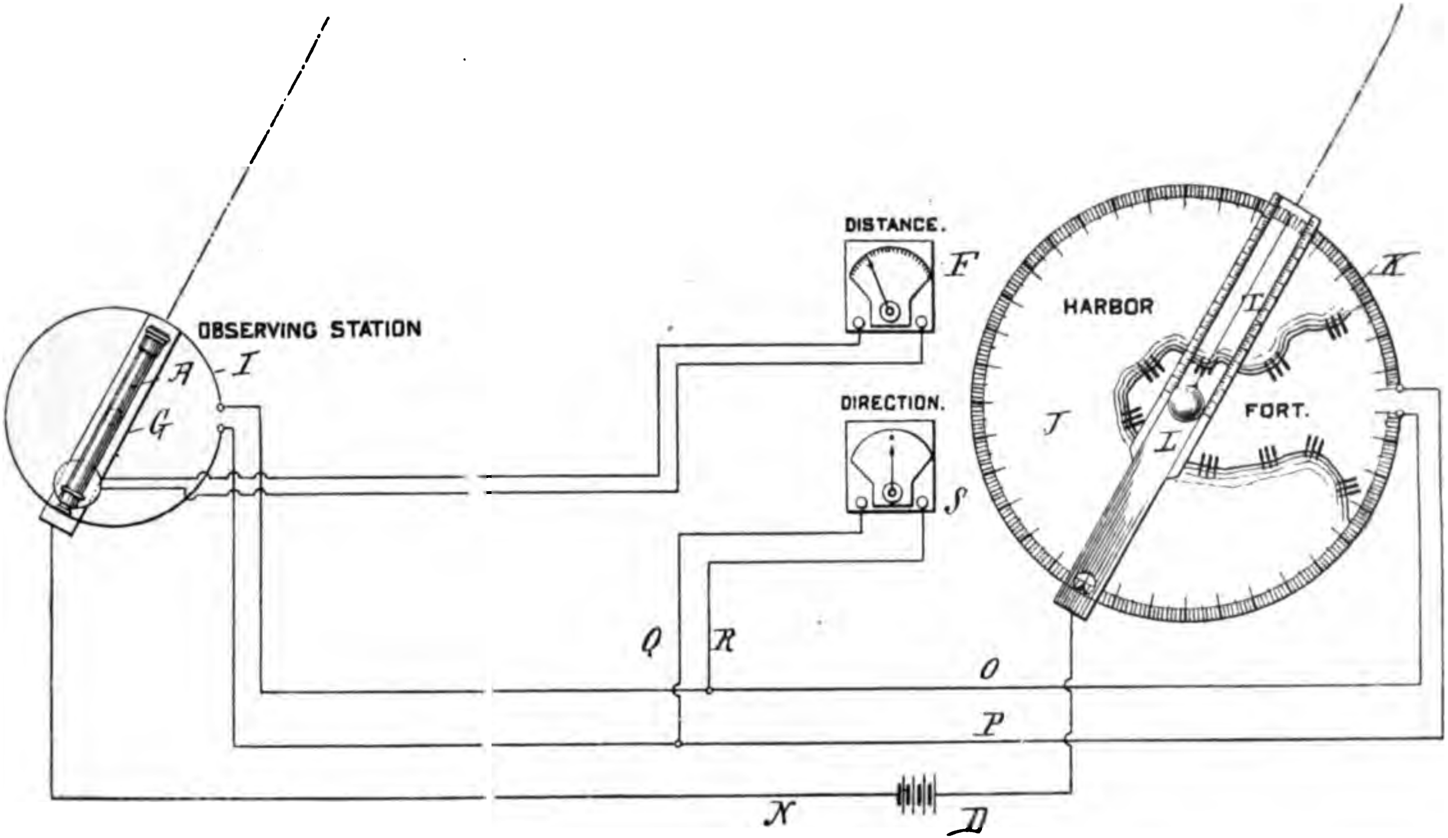


Fig. 27.—Position Finder.

height of the telescope above the level of the object, the galvanometer deflection will indicate the distance of the object from the telescope, for which purpose the galvanometer may be once for all graduated in any suitable unit, such as meters or yards. Hence, if the galvanometer be located at a station distant from that telescope, an observer at that distant station, by reading the galvanometer, can recognize at once the distance of the object, while the person stationed at the telescope has nothing to do but to keep it properly directed upon the object.

The telescope pivot is carried upon a bar G, Fig. 39, which is pivoted upon a circular table, H. Placed in a groove around the periphery of this table is a wire I, Fig. 37, of conducting material, having a uniform resistance per unit of length. Upon the bar G is supported a contact piece or wiper, as will be more particularly explained hereinafter with reference to Fig. 39, which contact piece or wiper always bears upon the wire I. At the distant station, Fig. 37, there may be arranged a circular table, J, having around its periphery a wire, K, similar in all respects to the wire I. Upon the table J is pivoted a bar, L, which bar L carries a wiper or contact point which constantly presses upon the wire K. The contact point on the bar G and the contact point on the bar L are connected by a wire, N, which also includes the battery D. The ends of the wires K and I are connected by wires O and P, and said wires O and P are respectively connected to wires Q and R, which lead to the terminals of a galvanometer, S. It will be obvious, by a simple inspection of the drawing, Fig. 37, that the wires I and K at the separated stations and the pivoted bars G and L, together with the battery and the galvanometer S, are connected in Wheatstone bridge circuit, and that a movement of either the bar L or the bar G, displacing the contact pieces over the wires K or I, will vary the resistance of the bridge arms so that the bridge may be brought into or out of equilibrium by the movement of these bars upon their pivots; and further, it will be obvious that the fact when equilibrium is produced in the bridge will be made manifest by the movement of the pointer of the galvanometer S. The construction is to be such, therefore, and the instruments at the separated stations are to be placed with reference to one another, so that when the bar L makes the same azimuth angle with reference to one end of its wire K as does the bar G, then the

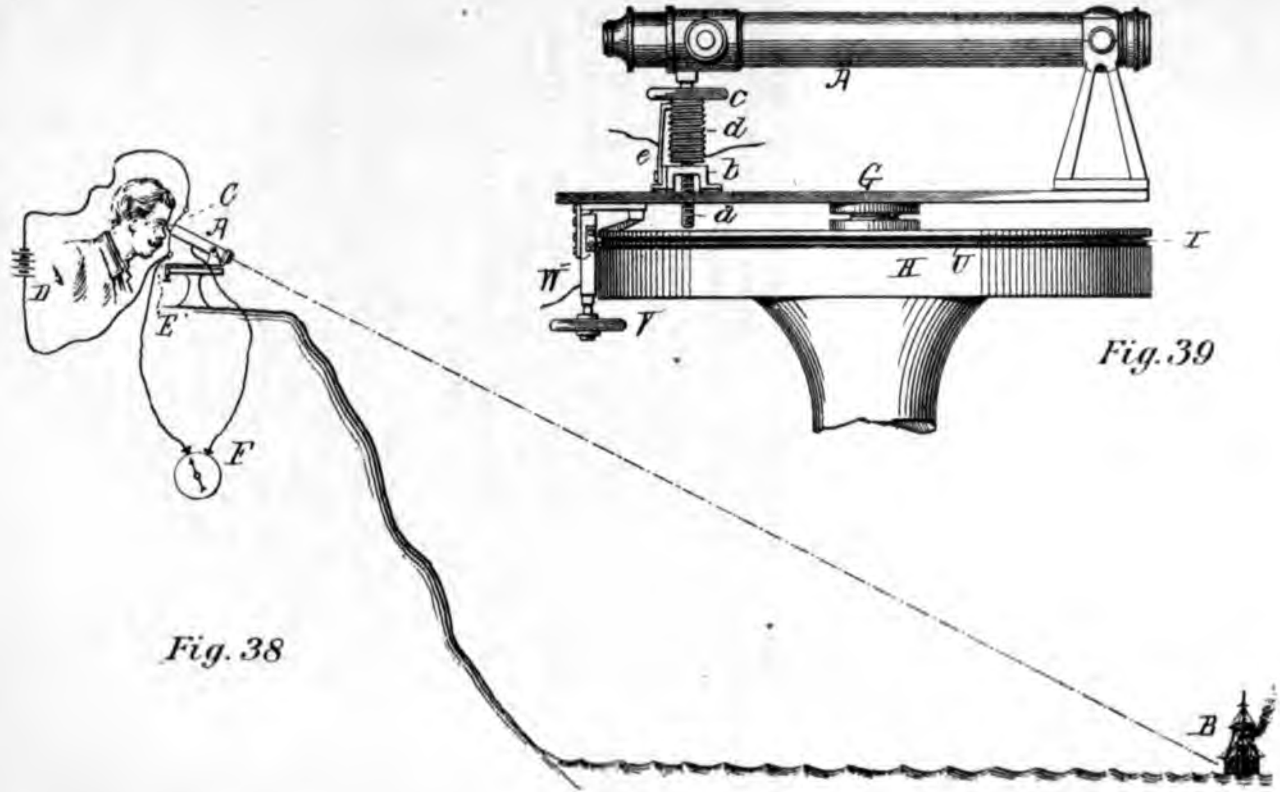


Fig. 38

Fig. 39

bridge will balance and the galvanometer S will show zero; so that if the telescope A, and consequently the bar G, parallel thereto, be directed upon the object, the galvanometer S will indicate zero when the bar L is placed similarly to the bar G. If, then, on the table J there be disposed a chart of the area to be protected on a reduced scale, such, for example, as is shown in Fig. 37, the direction of the object from the point of observation will be indicated by the position of the bar L. For convenience in this respect the bar L is made with an opening containing a longitudinal wire, T; the position of the object on the chart being of course along this wire; also on the sides of the opening in the bar L may be marked a scale of distances, in yards or meters.

The operation of the whole apparatus is therefore as follows: The telescope A is depressed, and also moved in azimuth, until aligned with the object. Inasmuch as the distance of the object depends, as has already been explained, upon the angle of depression, and as this angle is measured by the galvanometer F in terms of distance, it is plain that if the galvanometer F be located at the station distant from the observer, then from that instrument the distance of the object can at once be read off. Simultaneously the movement of the telescope A in azimuth disturbs the balance of the bridge which includes the galvanometer S. The observer at the distant station then moves the bar L until the galvanometer S, placed near to him, shows zero. When this is done, the position of the object will be somewhere along the line of the wire T; and its exact point along that wire T is immediately found by noting on the scale on the bar L the distance corresponding to that shown by the galvanometer F. The bearing and distance of the object thus being ascertained, it remains simply to communicate this information, by any suitable means, to the guns or battery.

It will be apparent that one of the advantages of this instrument is that it is directed by a single observer, and that the simple operation of aligning it with the target instantly causes, at the distant station (the bar L there being suitably manipulated) indications from which the bearing and distance of the object may at once be recognized.

Referring now to Fig. 39, there is here illustrated, in detail, the mechanical construction of the telescope A and its supports.

The table H may be of any suitable material, and should have embedded in it a ring U of hard rubber or other insulating material, in which ring is the groove in which is placed the wire I. The bar G is conveniently rotated on its pivot by means of the hand wheel V, the support for which wheel carries the contact point or wiper W. The inner end of the telescope A is supported on the vertical screw *a*, which passes through the fixed nut *b* which is carried on, but insulated from, the bar G, the insulation being placed below the nut. The screw *a* is rotated to depress and lower the telescope by means of the hand wheel *c*. Secured upon the screw is a cylinder, *d*, of ebonite, having upon its surface a spiral groove in which is laid the german silver wire corresponding to the body C, Fig 38. *e* is a contact spring which always bears upon the wire C, and this spring is supported upon, but insulated from, the nut *b*. In this device, instead of causing the telescope A to carry the contact and move it over a fixed body, C, as in Fig. 38, the body C, by the rotation of the screw *a*, is made to move under the fixed contact piece *e*; the relation of the parts being thus merely reversed. The circuit connections are the same as is indicated in Fig. 38, that is to say, the battery terminals lead to both ends of the wire C wrapped upon the cylinder *d*, and the terminals of galvanometer F connect respectively with the contact wiper *e* and one end of the wire C. The movement of the telescope A in azimuth is three hundred and fifty degrees.

Horizontal Base Position Finder.

If the ground in the vicinity of the water is not high enough to offer a sufficiently long vertical base line for a depression position finder, it becomes necessary to use a horizontal base. The solution of the problem of so employing a horizontal base has been attempted during many years, but, so far as the writer has been able to ascertain, the only system that has done it successfully is the one here described, in which telescopes located at the opposite ends of a base line carry contacts which sweep over arcs of wire that are connected together in the same way as in the range finder just described. The position finder referred to in the Italian report, of which an extract has just been given, is of this character. Another form is shown diagrammatically in Fig. 40, in which—

A B represents the parapet of a fortification. The distant object is supposed to be located at C, and it is the position of this object which is to be determined upon a suitable chart, D, on which the fortification line A′ B′ appears on a reduced scale.

E is an arc of conducting material.

F is a telescope or alidade arm pivoted at one end at F′, with its free extremity moving over and making contact with the arc E.

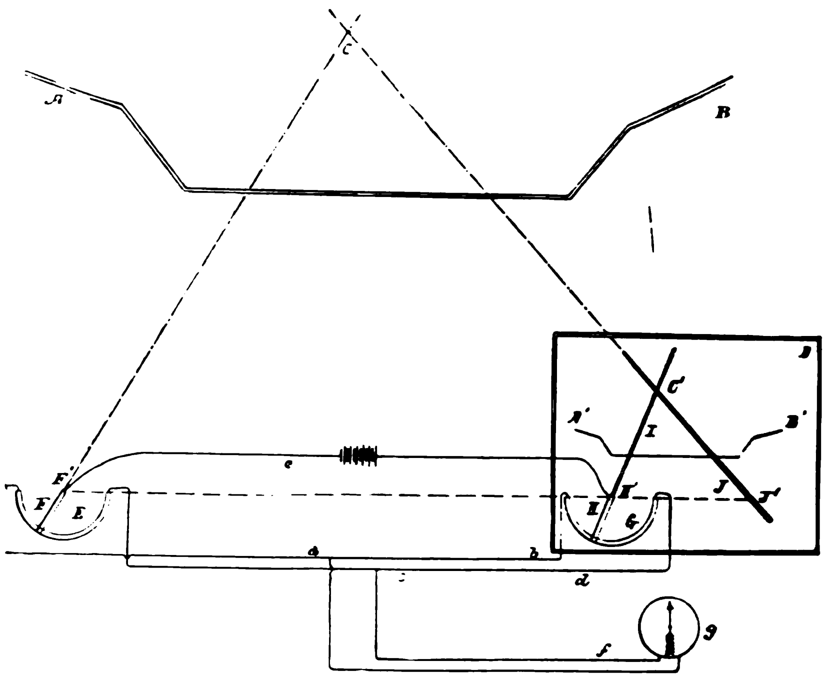


FIG. 40.—POSITION FINDER.

G is an arc similar in all respects to the arc E and located in suitable proximity to the chart D.

H is an arm pivoted at H′ and having its free end sweeping over and making contact with the arc G and carrying a pointer I.

a b c d are members of a Wheatstone bridge connecting the arcs E and G.

e is a loop including the battery, and *f* the loop including the galvanometer *g*.

It will be obvious that when the arm H is set upon its arc G at the same angle to the line H′ F′ as the arm F upon the arc E, then the bridge will balance, and the galvanometer will indicate zero, and hence, inasmuch as the telescope F points to the actual object C, the arm H will point to the corresponding position of the object C or C′ on the chart D. Pivoted upon the chart D at J′ is an arm J, which arm may be provided with a telescope or alidade so that it may be directed upon the object C. The arm J is long enough to make intersection with the arm I. If then the arm J is trained directly on the object, inasmuch as the line H′ J′ joining the pivots of the arms I, J on the chart D corresponds to the base line F′ J′, extending between the distant stations, and as the angle C′ H′ J′ equals the angle C F′ J′, it follows that the intersection of the arms I and J at C′ indicates the position of the object C upon the chart D. The chart being drawn to scale, it is easy to recognize at a glance both the direction and the distance of the object C.

The latest form of this position finder is that installed at Fort Hamilton, and represented in Figs. 41, 42 and 43. The larger of the instruments is fitted with a plotting table as well as a telescope.

The resistance wire for each instrument is wrapped in a spiral around an insulating cylinder instead of being laid in the form of an arc, and differs from the new form of range finder principally in the addition of the plotting table. The operation of using it is much the same as the operation of using the earlier form of position finder just described. The observers point their telescopes so that the cross wires rest on the mast or funnel of the enemy's ship above the smoke. The reader at the plotting table, usually an officer, keeps moving the electrical contact of his instrument so as to keep the galvanometer needle always at zero, thus maintaining the corresponding pointer always in parallelism with the telescope at the distant station. The reader and the observers have telephone receivers on their heads and long distance transmitters on the telescopes, so that they are in constant communication. As soon as each observation is made the officer orders "rest," and both observers cease observing for awhile. At the end of twenty seconds the officer orders "mark." The observers again sight their telescopes on the target and keep the cross hairs exactly on the mast until the officer,

at the end of ten seconds, again orders "rest." The officer now notes the intersection of the pointers and marks it on the chart by a spring pencil, connects it to the position just preceding by a short line, and prolongs this line to an equal distance beyond the last point. The end of this line is clearly the position which the ship will probably occupy at the end of the next thirty seconds, and it is this "predicted position" which is signaled to the guns. But the frequency of the observations and the length of time over which the prediction extends, may be made to vary at will.

With a little practice the work of plotting and predicting positions occupies but a few seconds. To facilitate the operation, the apparatus has been given the form shown in Figs. 41, 42 and 43. The pointers are heavy steel bars graduated every 10 yards up to 10,000 yards and supported at their outer ends on light brass rollers. The spring pencil fits in a slider that moves along one of the pointers. When the slider is pushed along its pointer until its edge rests against the other pointer, the middle of the spring pencil is exactly at the point of intersection of two lines drawn from the centers of the pivots of the pointers; so that to mark the position on the chart of the enemy upon whom the telescopes are directed it is merely necessary to push down the spring pencil with the finger. The distance of the position from this instrument can be read at once from the graduated pointer through an opening in the slider, and the direction can be read at once from the graduated disks shown on the right of Fig. 43.

As installed at Fort Hamilton, the base line is 985 yards. In "tracking" moving vessels and in plotting the positions of known objects situated in different parts of the lower bay, some as distant as 9000 yards, no error as great as 1 per cent. was discovered on the official or the preliminary trials.

Care of the Electric Instruments.

The principal enemy of the electric instruments is the same as that of all other instruments used on shipboard, namely, sea air and moisture. For this reason, the galvanometer cases should not be opened, except when necessary, and should be left open as short a time as possible.

In case of any trouble whatever with any of the electric instru-

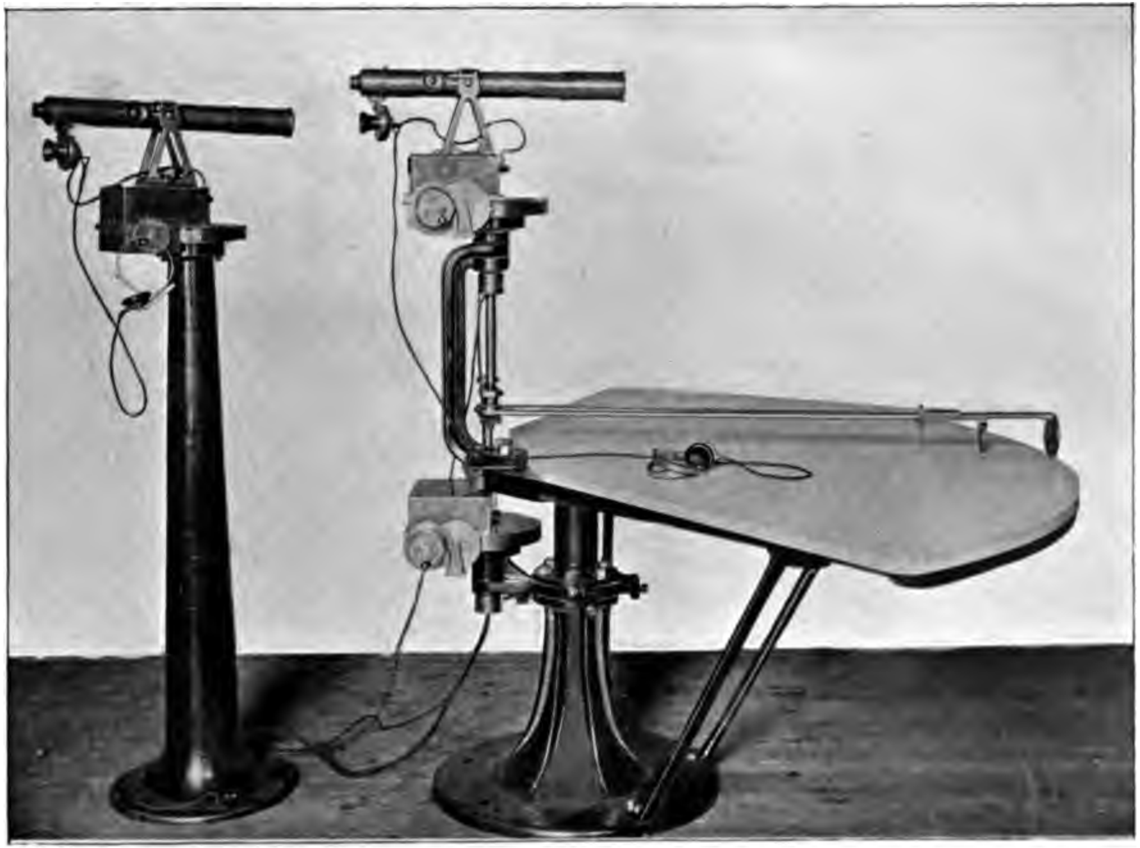
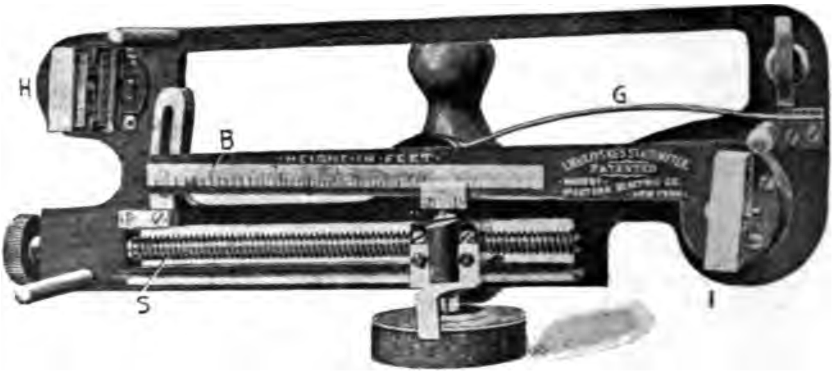


Fig. 41.—POSITION FINDER.

So that in either case the measurement involves the measuring of sine ABT.

To accomplish this with the stadimeter, bring the reflected ray from the top of the object into coincidence with the direct ray from its bottom, by moving the index bar which carries the index glass I on its pivot, in the same manner as in using the sextant. To move this index bar, rotate the micrometer head M. The sine of the angle through which the index glass has been moved is clearly the amount by which the micrometer



STADIMETER.

screw has moved longitudinally, divided by the distance from the pivot of the index bar B to the point on its edge where the force of the micrometer screw is applied. The german silver spring G presses the index bar against the end of the micrometer screw, and prevents lost motion.

Now, by the theory of the sextant, the angle between the reflected ray from the top of the object and the direct ray from the bottom of the object is twice the angle through which the index glass has been moved out of parallelism with the horizon glass H. Therefore, assuming that for such small angles as those here used the sines of angles are proportional to their arcs—

$$AT \div BT = 2 \cdot \frac{\text{Length of movement of micrometer screw}}{\text{Distance from pivot to point of application of screw on index bar}};$$

or,

$$BT = AT \div 2 \cdot \frac{\text{Length of movement of micrometer screw}}{\text{Distance from pivot to point of application of screw on index bar.}}$$

As the length of movement of the micrometer screw longitudinally can be determined by the amount of angular movement of the micrometer head, it is plain that, if we know the pitch of the micrometer screw, the micrometer head can be graduated in units of distance and the index bar in units of height, or *vice versa*.

In the stadimeter this is done, and furthermore the point of application of the micrometer screw on the index bar can be varied at will. This is accomplished by mounting the micrometer screw on a block or nut which rides on the long screw S, so that by turning S the block or nut is moved in either direction.

To use the stadimeter to measure the distance of an object whose height is known, set the micrometer screw opposite that graduation on the index bar which indicates its height in feet, and bring into coincidence the reflected image from the top of the object and the direct ray from its bottom. The distance of the object in yards will then be found opposite the pointer on the micrometer head.

To measure the height of an object whose distance is known, assume the height to be 100 feet, and set the micrometer screw at the 100 mark on the index bar. Proceed as before, and read off corresponding distance (which may be called D) upon the micrometer head. Obviously,

$$\text{True height} : 100 = \text{true distance} : D.$$

$$\text{True height} = \frac{100 \times \text{true distance}}{D}$$

The stadimeter may now be set at the true masthead height and used as explained before.

When employed in connection with the range finder in a naval battle, take the distance of the enemy with the range finder very carefully before the action has become hot, bringing her as nearly abeam as convenient, and when distant, say, 2500 or 3000 yards, find out her masthead height simultaneously with the stadimeter, and set the stadimeter at this height and keep it ready for use. If afterwards the range finder becomes disabled, or if it cannot be used for any reason, proceed with the stadimeter.

A moderately skillful observer can get eight observations per minute.

The foretop is a good place in which to use the stadimeter, the observer being connected by speaking tube, telephone, or range indicator with the person who telegraphs the ranges to the guns.

In fleet actions endeavor, if possible, to get exactly the masthead heights of all the enemy's ships and make a memorandum, to be used when required.

The manner of using the instrument is the same as that of the ordinary sextant, as are also the precautions to be observed regarding the parallelism of the mirrors.

To make the horizon glass parallel to the index glass, when the micrometer reads INFINITY, move very gently the two set screws at the bottom of the horizon glass, slacking one screw and screwing up the other, until the direct and reflected images of a distant object coincide. In using these screws remember that the reflected image seen in the mirror of the horizon glass goes in the direction in which the screws are advanced. If, for instance, the reflected image is below the direct image, screw up the lower screw and slack the upper one. Whereas, if the reflected image is above the upper one, slack the lower screw and screw down on the upper one. Do *not* turn the micrometer head on its screw to accomplish this purpose.

When a very careful observation is desired, as in navigation, it is very desirable to assure the parallelism of the horizon and index glasses after the carriage has been set at the proper height.

Be careful not to force the micrometer head to turn, in case it turns hard, because the reason for its turning hard will be that the micrometer screw is clamped; and if force is used, the head may turn around independently of the micrometer screw. For this reason do not clamp it unnecessarily tight, and do not clamp it at all unless necessary.

The micrometer head is secured to the micrometer screw by the friction of three stout set screws, in such a position that when it reads INFINITY, the edge of the index bar is parallel to the slot along which the micrometer carriage moves on the long screw. If the horizon glass is adjusted to parallelism with the index glass when the micrometer reads INFINITY, and when the micrometer screw is set opposite any height graduation (say 200), the mirrors will remain parallel if the screw is moved opposite any other height graduation (say 60); because the index

bar remains parallel to the movement of the micrometer carriage. But if, from accident, the micrometer head is forced to turn independently of the micrometer screw, then when the micrometer reads infinity, the screw will have placed the index bar at an incorrect distance from the long screw, so that if the horizon glass be made parallel to the index glass when the screw is opposite any height graduation, and if the carriage be then moved opposite to another height graduation, the index bar will also move and the parallelism of the mirrors will be destroyed.

This contingency is not probable, but in case it occurs, the micrometer head can be returned to its correct position on the screw by slacking the set screws and turning the head around till the adjustment marks scratched on the screw and the micrometer head near the set screws come opposite each other.

In case some accident should befall the instrument such that a total readjustment of the micrometer head on its screw becomes necessary, also to adjust during manufacture, proceed as follows:

Place the screw opposite 200, align the index bar approximately by eye, slack up the three set screws, make the micrometer read infinity, and reclamp the set screws. Make the mirrors parallel by moving the horizon glass, until the direct and reflected rays from a distant object coincide, as in adjusting a sextant. Move the micrometer carriage down to 60. Bring into coincidence the direct and reflected rays from a distant object, by turning the micrometer head.

If the infinity mark is now to the *right* of the reference mark on the pointer, it is because the index bar has moved further away from the long screw, showing that when the micrometer head was at infinity and the screw was at 200, the screw was forcing the index bar too far; so that when the screw got down to 60, and was further away from the pivot of the index bar, it did not force the index bar so far, and hence the micrometer head had to be turned to the right, bringing infinity to the right of the reference mark, in order to bring the index glass back to parallelism with the horizon glass.

If when the carriage is moved down to 60, the infinity mark is to the *left* of the reference mark, when the mirrors are parallel, the same reasoning shows that it is because the then existing position of the micrometer screw does not force the index bar far enough away.

Therefore, in the first case, when the mirrors are parallel, the screw is too far advanced; and in the second case, too little advanced.

If on going to 60 the distance in fractions of an inch that the infinity mark is to the *right* of the reference mark is A, turn the micrometer screw until the mark is about $\frac{1}{2}$ A to the *left* of the reference mark and clamp the micrometer screw. Go back to 200 and make the horizon glass parallel to the index glass. Go down to 60. If now, in order to make the index glass parallel to the horizon glass, the infinity mark must still be moved to the *right* of the reference mark, the infinity mark must be moved farther to the left of the reference mark than it was just placed, and the above operation repeated. But if the infinity mark is found to the *left* of the reference mark, the micrometer head has been moved a little too far to the left of the reference mark and must be moved back a little, and above operation repeated.

If on going to 60 the first time, the infinity mark is found to be to the *left* of the reference mark, a distance equal to A, the infinity mark should be moved about $\frac{1}{2}$ A to the *right* of the reference mark, the screw set 200, mirrors made parallel, and the same operation followed as above outlined, until the mirrors remain parallel when the micrometer carriage is at 200 and at 60.

If, when the screw is opposite graduations below 100, the variations from infinity are not more than $\frac{1}{32}$ inch, the error is negligible for practical purposes.

When the proper position for the micrometer head on its screw has been found, clamp the micrometer screw, slack the three set screws on the micrometer head, turn the micrometer independently of its screw until infinity mark is opposite the reference mark, tighten the set screws carefully and then unclamp the micrometer screw.

In case the known height of an object is more than 200, set the screw at 200, and measure the distance correspondingly, which may be called C. Now D, the true distance, is found as follows:

$$D : C = \text{True height} : 200$$

$$D = \frac{C \times \text{True height}}{200}$$

The stadimeter has been issued to nearly all our ships in commission; the New York, being a flagship, has two. The Texas has one for ordinary ship work, and another for use in connection with the range finder, the idea being that constant use of a stadimeter, often in vain, while not impairing its value seriously for use in fleet tactics, will injure the mirrors materially for fine gunnery work between 2500 and 3000 yards.

Note.—Some later instruments are made of an alloy of aluminium and nickel, which is very hard and durable. The weight of a stadimeter made of this alloy is less than two lbs.

Direction of Future Progress.

It would require an inspired prophet to foretell this exactly, but it would require only a man of observation to predict certain phases of it within a small probability of error.

At the present time in various branches of engineering we see the use of electrical appliances gaining so rapidly on hydraulic and pneumatic appliances and on auxiliary steam apparatus, that he must shut his eyes and close his ears very tightly who cannot see and hear the approaching triumph of electricity. Can we then not feel it as an absolute certainty that electric power will soon be used in all our war-ships—and merchant-ships also—for auxiliary engines? There is a predilection in the minds of a few officers in favor of hydraulic apparatus; and many officers like steam. Doubtless there may be some who prefer pneumatic apparatus, but they are few in number and hard to find. The only important difference of opinion, therefore, seems to be between steam and electricity; because steam has the undeniable advantage of saving weight and space and money; but how there can be any question between the relative advantages of electricity and hydraulics it is difficult to imagine. Whatever faults electric power on shipboard has (such as the necessity for a generating plant, the increase of parts, etc.), hydraulics has in at least an equal degree. And it may be iterated and reiterated that every advantage which hydraulics possesses, electricity possesses in an equal degree; and for every disadvantage which electric power possesses, hydraulics possesses another at least equally great. Yet electricity possesses many advantages which hydraulics does not possess, and hydraulics has many disad-

vantages which electricity has not. The whole trend of engineering professions is away from hydraulics and towards electricity. This is true even in ship work, for many people now understand what it means to keep valves and joints from leaking under high pressure, and recall the fact that in the Maine and the Benbow the water simply froze everything stiff and tight, and put the ships absolutely *hors de combat.*

The electrical arts are certainly younger than the hydraulic arts, and yet it is time to cease to regard electricity as a species of illusion or humbug, and to cease to look on an electrician as a species of fakir or magician. As a matter of fact, in all the colleges and electric companies of the country we find men of the highest order of intellect and education engaged in the study of electricity from both a scientific and an engineering standpoint, and the amount of money invested in it is many times greater than that invested in all our ships put together.

So, in deciding between hydraulics and electricity for auxiliaries in ships let us not be blind to the fact that if we decide in favor of hydraulics, we shall take a step backward as judged from engineering progress broadly considered, and place ourselves in the position of the only sensible juryman out of twelve.

Let us hope that we soon shall see a civilized modern ship, in which there shall be a fine large dynamo room, like those under the great New York hotels, where power will be generated for lighting the ship, making the signals, hoisting the ammunition, turning the turrets, operating the telephones, hoisting the boats, ringing the bells, weighing the anchor, sounding the alarms, running the launches, firing the guns, steering the ship, etc. And why should we not have a neat electric galley, such as are frequent in New York, where the meals of all can be prepared in cleanliness and quiet, with only a fraction of the fuss and confusion now attending the getting of the food and the coal and the heating of the water? And why should not both officers and men, when they go on night-watch, frequently in the wet and rain, be given a light repast, cooked on an electric stove, the size of a quart pot? Would the lookouts, or the quartermasters, or the officers, do their duty any less vigilantly if each had half a pint of hot coffee and a piece of nicely browned toast in his stomach? But whatever will be the exact paths that electrical progress will pursue, it is unquestionable that it will

strengthen the hands of the commander and give him better control of his forces both material and personal. This does not mean that a commander—either of a fleet or ship—will be expected to attend to all matters from the conning-tower, because that would overwhelm and overpower him with details which had better be left to subordinates; but it means that he shall be instantly informed of everything that happens, and that he shall be able instantly to give such instructions as he shall think best; it means, in other words, that he shall be able to direct affairs instead of being helplessly directed by them. The real end and aim of discipline is not to put men in the brig or to make them touch their caps, but to give a commander control of the forces under his command, some of which are at a distance. And above and beyond all questions of comfort, and of routine, and of detail, and of beauty, and of the nature of auxiliary engines, and of etiquette, is the question of the control of the ships, and of the various factors, offensive, defensive and directional, which give the ships their fighting value both singly and when combined in squadron. This means that signaling in its broadest sense—signaling both among the parts of a ship and among the ships of a fleet—must be improved, and then improved again and again, with never a rest in the onward march.

Signaling at Sea.

The electrician and the inventor recoil in despair before the difficulties which this problem presents. Guns, armor, hulls and engines change from year to year, but when we wish to signal by day we do the same things that Nelson did at a time when electricity and steam were almost unknown outside the "Proceedings" of scientific societies. Yet there must be a way to signal across the water; the question is "Where is the way?" If we can talk with ease from New York to Chicago, over a distance of 1000 miles; if we can telegraph over the same line 200 words a minute and receive the message printed on a page; if we can photograph the interior of the body of a living animal; if we can telegraph under all the oceans, and send news to and from all quarters of the world—why—why—can we not signal half a mile over the water from ship to ship?

The solution of the problem lies probably in the direction of

electric induction, the transmitters and receivers being so constructed, and so adjusted relatively to each other in resistance, inductance and capacity, that they will be in sympathy, or resonance, with each other, in which condition the receivers will be at their maximum sensitiveness to vibrations propagated from the transmitter.

Many experimenters have attacked this problem, but each, in turn, has been put to rout, "horse, foot and dragoons." Among others, the writer in 1887 essayed his feeble powers, both at the New York Navy Yard and the Stevens Institute. In one experiment he used the U. S. S. Atlanta as the transmitter and the U. S. tug Nina as the receiver, wrapping them horizontally with many turns of wire. The Atlanta's wire was coarse and traversed by the dynamo current; while the Nina's wire was fine and in circuit with two telephones. The Atlanta then formed the largest electro-magnet ever constructed, and she still holds the record; but the experiment, like all the others, was a failure in a practical sense, though signals were transmitted over, say, a hundred feet. On other occasions, the writer, amplifying some experiments of Prof. A. Graham Bell, signaled by means of electric currents propagated through the water. Fairly good signals were sent a hundred yards, but they could not be induced to go any farther. It is to be said, however, that all these experiments in signaling were conducted by the various experimenters in a desultory fashion, and before the laws of electrical sympathy or resonance were well understood. And it is the belief of the writer that, if some competent person were given proper facilities by the Government, or by private parties, he could develop a system of signaling which would be equally good by day or by night, in clear weather or in fogs. Until then we shall have to be as happy as we can with the Ardois system and electric wig-wags; unless some good magician, with a wave of his wand, will bring into being some simple and beautiful discovery or invention, the like to which we do not dream of now.

Central Stations.

The problem of insuring rapid and sure communication among the various compartments of a war-ship has brought about the

same solution as a similar problem has brought about in modern cities—a "central station"; and the more the subject is considered, the more plain it becomes that a central station is the only thinkable solution in a city, a large building, or a ship. And not only this, but in a war-ship the solution is the more complete, because, added to all other conditions of the problem, is the important one that the means of communication and the operators must be as much protected as possible. It is an admitted fact that the problem of where to put the conning-tower and how to arrange it has not yet been solved, but the central station below the water-line comes pretty near solving it, because much, if not all, of the complicated apparatus heretofore put in the conning-tower can now go in the central station, and the captain needs only a telephone or large speaking-tube connecting him with his aide in the central station. The conning-tower being thus relieved of most of its apparatus, can be made smaller, and for a given weight, covered with thicker armor, so that it will be extremely hard to hit and almost impossible to destroy.

It has been proved in service that speaking-tube communication, or even telephone communication, is very inefficient between the conning-tower and those parts of the ship, such as the battery, turrets, engines, etc., in which there is much noise; and that it is utterly useless for communicating simultaneously with several persons under the conditions of action or even general quarters. But telephonic communication can be made perfectly satisfactory between two people, one in the conning-tower and the other in the central station; because a central station can be made quiet, and because the two people, say the captain and his aide, can keep their telephone receivers on their heads all the time and become accustomed to each other's voices and modes of intonation. Then from the central station reach out the various visual signals for silently telegraphing ranges, battle orders, directions to the helm, engines, etc.; and there is received news from all parts of the ship for transmission to the captain. The central station should be as near the conning-tower as possible, for obvious reasons; but even if in some ships it should have to be at some distance, yet the telephone will put matters in the same condition as if the captain and his aide were absolutely in the conning-tower together and holding verbal communica-

tion. Aside from the value of protection for all the interior signaling apparatus, both for sending and receiving, the advantage of having all the operators in a quiet place, where they will be as free as possible from exciting and disturbing causes, is clearly of paramount importance

It is to be hoped that the tremendous advantages to be derived from a central station properly situated and equipped will be more and more fully recognized, and that in the original designs of our new ships the central stations will be really properly situated and equipped. It would seem that the principle governing the arrangement of electric apparatus in ships should hereafter be the same as in large establishments on shore, viz., that all apparatus which is delicate, or which requires great skill in its operation, should be confined to the central station, and that the apparatus placed elsewhere should be of the simplest character, as regards both its construction and its manipulation.

If this plan were adopted, we could get rid of the armored tube with its multiplicity of chains and wires, a blow on which from a heavy shell would paralyze all means of communication and leave the captain helpless. We might even get rid of the conning tower itself; because all that would be needed would be a strong steel post, or bar, behind which the captain could stand, like a sharpshooter behind a tree; with perhaps a quartermaster near him, to direct the helmsman in the central station.

It is now proposed that the executive officer shall be stationed in the central station in action, in order that, if called upon to take the captain's place, he shall be *au courant* of what is going on. If this be done, why should not the executive officer be the gunnery officer of the ship, and charged especially with the matters relating to her fighting efficiency, her guns, turrets, electric mechanism, etc.? Then he would, if called on to assume command of the fighting machine, do so with an intimate knowledge of all her fighting factors, instead of with an intimate knowledge of liberty lists. But, as Rudyard Kipling would say, "That is another story."

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NAVAL WAR COLLEGE.

OPENING ADDRESS, SESSION OF 1896.

Delivered June 2, 1896,

By HON. WILLIAM MCADOO, *Assistant Secretary of the Navy.*

Mr. President and Gentlemen:

I thank you for the unusual, and I fear, unmerited honor of again being asked to address you at the opening of another session of the War College. It is unnecessary for me to say to you how successful this institution has been. Those who are concerned with the administration of the Navy have learned to regard it as one of the great arms of the establishment for national defense. The military art, like others, has been progressive; and preparation, method, and order are the prime factors for success. Our Civil War revolutionized naval architecture, and the Franco-Prussian War demonstrated that careful organization, deep study of possible problems, and a thorough knowledge of a nation's resources, as well as the strength and weakness of one's opponents, can overcome the bravest people under otherwise able and gallant leaders. In short, the largest side of modern war is the business one. It is quite possible that no amount of preparation and organization could save a nation of cowards, but while races may differ in bravery, no nation is wholly wanting in the heroic. This school, therefore, is doing a work for this country of an importance so great that it could not well be exaggerated. While it is possible that every solution attained here may not be a perfect one and would have to give way to changes in the face of actual facts at the time of conflict, still there can be no doubt that the plan of national

defense from the naval standpoint, so thoroughly elaborated here, is of the greatest value to the country, and would receive primary consideration in case of war. The College does not pretend to stand for the whole ability of the United States Navy. No college can give a man genius, but a course in college will help most men of even great natural ability. I am saying this by way of prelude to the subject which I have chosen for to-day's address. Dropping into a habit which I notice is assumed by certain popular preachers, of prefacing their sermons with a few comments on the events of the day, I briefly recapitulate the line of thought suggested in the former addresses, namely, that force is yet, and will continue to be for long ages, a prime factor in civilization: that the diplomacy of a nation, however able, carries with it no weight unless backed by power, especially on the sea; that war in a republic is apt to be more sudden and precipitous than under the most autocratic of monarchies; and lastly, that we, as a nation, have reached the point in our career where, whether we will it or not, we are obliged from inexorable circumstances to assume great international responsibility and obligations, more especially on this hemisphere.

I am quite aware that these views do not harmonize with those of some of the learned schoolmen of our day. To those who hold these views this is not a matter of serious import; to be learned is not always to be wise; to be prejudiced and conceited is to often fail to be patriotic; to dream one's premises instead of knowing them is not to reach sound conclusions. It is instructive and reassuring to glance along the lines of the imperial progress of the Republic and note the illustrious but discredited Jeremiahs who have wailed their protests against such advancement. They rent the heavens with protests against the annexation of Louisiana, and prophesied that our acquisition of that territory, with its mixed peoples, would be the destruction of the American Constitution and Anglo-Saxon civilization. They protested before high heaven in the Congress of the United States against the War of 1812, and invoked the illustrious shades of English literature, in whose genius we have a common pride, to halt us in the assertion of our national rights as against a position of colorless colonial dependency. They poured hot vials of satire and unsparing abuse on the loyal public men of the day who had the nerve and manhood to engage in a conflict

which, for the first time, gave to the United States a place among the great nations of the earth, and won for its people and its flag enduring respect on land and sea. They anathematized the heroic American who carried our flag into the capital of Mexico and added to the national territory; and in the period which preceded our great Civil War, were their unfruitful prophecies, oral and written, collected into one vast heap, it would reach so high as to be crowned with eternal snow, as they are now with the mould of disuse and disrespect. In the dusty sub-cellars of public libraries lie mouldering heaps of this literature of false premises and absurd conclusions. These false prophets are good men too overburdened with their own virtues and cruelly overladen with excessive wisdom; otherwise men of learning and high social position.

From dizzy, platitudinous heights, with a delightful self-complacency that excites smiles instead of frowns, they have protested against every forward movement with a dull dogmatism which, if it were as weighty in fact as in assumption, would arrest the spheres and crush the world. Heedless mankind, with a void in its stomach, an impulse in its heart and an idea in its head, goes resistlessly on in its own blind way, and these sons of omniscience go theirs.

He must be wholly ignorant of the existing facts around us, and unobservant of recent occurrences and their significance, who does not realize how much naval strength makes for our peace, the security of our rights, our commercial growth, and the assured success of our policies. A proper navy would do more to secure peace for the United States than endless speeches and pacific resolutions. It is not the armed but the unarmed nations that are in danger of war, spoliation and outrage. In the political world, as in the natural, inertia and stagnation mean death; activity and the contest of opposing forces stand for life. This country of ours cannot stand still, nor can it evade the awful responsibilities of destiny and environment. The accidents of time may retard but they cannot prevent the great events of destiny.

The subject which I have chosen for to-day's address is Naval Administration. I think you will all agree with me that however able the personnel of the Navy may be, however excellent the matériel, unless the establishment as a whole is well orga-

nized and properly administered, the Navy cannot be efficient. A bad or lax administration in time of peace makes a navy incapable of carrying out the wisest solutions of any problem in time of war. This subject of naval administration has long been a subject of discussion and dispute, because every one realizes how entirely essential it is to the carrying out of the ends for which the establishment was created and carried on. A weak, foolish, or worse administration of the Navy would discount all the bravery and ability of the military units that go to make up the organization. The best troops will fail in the hands of a commander in whom they have no confidence; the best business will be wrecked if those at the head are incapable of executing its affairs. The machinery of naval administration is complex, and more difficult to handle in many ways than that of other branches of the Government. In the first place, it is a military body, or at least it ought to be. It is not a line of merchant steamers, nor a manufactory, nor a hospital, nor a counting-room, and yet it combines the characteristics of all these. And over this purely military body, under the constitution and laws of the country, there is one supreme civil head, the President of the United States, and under him, as his direct representative, the Secretary of the Navy, also a civilian. At the outstart, therefore, we have apparently presented to us the anomalous situation of a civilian head, possibly untrained in the military art, and almost surely without naval education, placed in direct, entire, and unquestioned control of a military organization, hedged about with questions of the most technical and difficult character from the purely professional point of view. And yet, under our system of government, this is the only possible way in which a military establishment could at all exist. Under popular government, either in England or the United States, the military arms are to be always subordinated under the constitution to the civil authorities. In other words, the people are unwilling to divorce the military branch of the Government from other branches of the governmental machinery, or to allow it at any time to get beyond their control. To this end, it is the policy of all popular governments that the military organizations shall be kept in close subjective touch to both the legislative and executive branches of the Government, and there is no reason why, under wise laws and able administrators, this plan

should not work well. It is no disrespect to the highest professional opinion to note that in the affairs of the world, the trained minds of the judges of our courts and the administrators of great businesses, and indeed even the juries, have every day to pass final judgment upon technical subjects, and often settle disputes as to rival professional claims. As I said, however, its wisdom or unwisdom need not be discussed, because it is an established fact which can not and will not be changed. At first glance it would seem to create a very delicate relationship between the head of the Navy Department, as the civilian and supreme administrator, and the professionally educated officers who are subject to his command, and through him carry out the orders and policy of the government of the day. It begets for the naval officer in a country like ours, where public opinion is so critical of all in official stations, and so free in its expressions, a position requiring sound judgment, good tact, and a high degree of patriotism.

He is of course bound, as is proper, to give implicit obedience and respect to the civil authority, and on the other hand, from the professional standpoint, he is, in the nature of things, more or less divorced from the ordinary pursuits and politics of his fellow-citizens. He must avoid extremes. He cannot become so narrowly professional as to get entirely out of touch with the country and its institutions, nor remain ignorant of the facts, events and occurrences of the great life which struggles and surges around him. And on the other hand, as a professional military man, bound on sacred honor to obey the proper civil authorities under the constitution, he cannot, without impairing his usefulness and losing his professional character, become an active partisan in the politics of the day, nor an eager participant in commercial and business enterprises. There is some analogy between the soldier of the cross and the soldier of the sword in their relations to the state and general society. They must mingle in the affairs of their fellow-men and yet, in a certain sense, they must stand apart. A high sense of honor and great disinterestedness should be the badges of their calling. Between these possible difficulties there must be a sound middle ground for an American naval officer. He should of course not be a politician—certainly not in the ordinary sense—but on the other hand, if he does not from active sympathy take a deep and abid-

ing interest in the affairs of his country, its prosperity at home and its dignity abroad; if he is lacking in the American spirit and out of sympathy with American institutions, and not thoroughly cognizant of the relationship which he bears to the Government as a member of one branch of the same; then, however marked his professional zeal, and however great his ability, he is in a false position; however otherwise honest he may be, he cannot bring to his work in a crisis that hearty enthusiasm which is only to be gotten by the stimulation of unselfish patriotism. I glory to say that, so far as I am aware, these possible dangers have no personal application to the officers of the United States Navy, and I only refer to this subject because I feel convinced that frequently the Navy, as a branch of the Government, an organization and an institution, presents itself to many circles and communities in our country simply and solely by the character and bearing of the individual naval officer with whom they are acquainted. Every naval officer in his own immediate circle, be it small or great, represents to a certain extent the whole Navy, and his manners and opinions make for or against the establishment. If it should once be suspected that he was out of sympathy and touch with the citizenship of which he is a member, or that he had gross misconceptions as to his relations to the Government and the people, he would, so far as his personal limitations admitted, be a source of weakness instead of strength to the Navy.

I was amused recently by a very excellent officer who said to me that when he made his occasional visits to the small town of the interior of the country where his people lived, that he was immediately greeted by the wiseacres of the village, who exclaimed, on seeing him, "Well, Bob, we see the United States Navy is home again." If you will ascertain the standing of that officer in the town you will come pretty close to getting its opinion on the naval question. I want the Navy to be popular because it deserves to be, and in a government like ours all institutions depend upon the good-will and support of the people, who, being in the main highly intelligent, demand reasons for the existence of everything around them. The naval officer will be at his best who is too professional to be a politician and not enough professional to lose interest in all the affairs of his country, never ceasing to be a student of her history, both civil and mili-

tary, and indeed to exercise his rights as a citizen when he so elects and opportunity offers. No one can realize better than the civilian head of the Navy, that while the Navy is a great and important branch of the Government, it is not all the Government, and the different parts of the governmental machinery are correlated and they all are subject to the policies, conditions and even passions of the times. It is, therefore, not so much what he would wish as what he can do; nor what would be the ideal conditions, but the best that can be gotten out of existing circumstances; nor so much how to manage an isolated and independent thing by itself, as to keep it in harmony with all the surrounding conditions and in quick touch with the most enlightened popular public opinion. It is a task requiring great judgment and marked ability, and it is not amiss for me to say, as this administration nears its close, that the present Secretary has shown himself equal to meeting it. I said we were not dealing with ideal conditions. I am foolish enough to think that if I were asked to recast the present system of administration, I would make many improvements in it; and I am quite sure, if it were left entirely to me, I would not hesitate about increasing the Navy, both matériel and personnel, to a proper degree of efficiency, but the advancement of a great principle like this is slow, painful and difficult. Like all human institutions of great worth, it has to rise steadily in the face of opposition and obstruction, both open and covert. It is strikingly strange, that those things which have most benefited mankind, even the Christian religion itself, have traced their pathway of progress through great peril and violent opposition.

To best understand the present naval administration it would be well to compare it with that of Great Britain, which can be readily done by reference to an excellent little book just issued, entitled "Naval Administration," by Sir Vesey Hamilton, late First Sea Lord of the Admiralty. The first thing to a successful administration by an incoming Secretary of the Navy is the selection of his professional advisers, in so far as opportunity is offered to him to do so. He must, in the nature of things, rely largely on them for the solution of the many professional and difficult questions which present themselves. To make a successful administration he should have at immediate call the very best professional talent in the Navy and occupying towards him the

most confidential and responsible positions. His term of office is fixed by law for four years. It has what might be termed its primary, intermediate and final stages. If he has not been fortunate enough to have gotten into the naval atmosphere through legislative or other connections with the establishment, he must, of necessity, however great his talents, begin an entire education, rapid as to time, and yet more or less comprehensive, before he can understand the duties of his office and the best interests of the service. He should be deeply concerned as to both the ability and wisdom of his professional associates. Under our system he has under him eight bureaus with their accredited chiefs, who in some degree might be said to constitute his cabinet. They do not, however, come into office with him, nor do they go out with him, but, as you know, come and go at irregular periods. Under the English system the member of the Cabinet who is at the head of the naval administration, and who, although theoretically but one of a commission for executing the affairs of the Navy, has practically the same powers as has the Secretary here (and in fact larger, as there is no reference to a superior authority such as the President), has associated with him four admirals who share his counsels and responsibilities and among whom are divided the superintendence of the detail's administration. It has not been so many years since the personnel of the Board was completely changed with the change of government, but this is no longer so. The incoming minister may either accept the existing Board or select a new one as he may elect, or he may call in new members without changing the whole Board. The Secretary of the Navy there has the same authority as with us, and although it has come to be held that he alone is responsible to Parliament and the country, and although he can veto the conclusions of the Board or those of any member of it, it is stated on high authority that he has never been known to do so in any important question, and indeed it has been said by English students of their system that the Cabinet member has performed his greatest and most essential duty by the selection of men of the best character and best fitted for membership on the Board. Indeed a Secretary of the Navy would have to be omnipresent as well as omniscient to pass successfully, of his own knowledge, on all the affairs of a vast establishment like this, scattered throughout our own country and all over the world.

The facts must filter to him through many sources, and his final information and advice must come from those officers who are the responsible heads of the different bureaus. Not alone is it necessary for the Secretary of the Navy to make wise selections for the distinct sea commands, but under our system he is called upon to make a great many selections for the manifold and various duties which are now given to naval officers.

Answering to a public demand, it has become the custom to place under naval officers a vast amount of work and the exercise of responsibilities entirely apart from those of a purely military character. It is the common experience of mankind, in both state and church, that however similar the professional training, the talents of men in any profession will differ; and indeed it is the trend of all professions in modern times to beget specialties in different lines. It therefore frequently happens in the Navy, as in other walks of life, that certain officers show great aptitude and develop natural talents for certain kinds of work outside of the limits of the strictly naval profession, and these officers do probably in these selected lines perform greater service for the country than in the strictly professional one. Under our system, however, the rule of rotation between sea and shore is more or less general. It is not necessary at this time to discuss its wisdom. Under the plan of selection as recently proposed in Congress, changes in this respect were contemplated. While in answer to public demand the duties of naval officers have been extended in many directions to the assumption of advisory, ministerial, and administrative functions, it might be well to consider if the present system of frequent and arbitrary changes in those employed in such service is beneficial or otherwise. It is quite possible that I am heretical regarding certain traditions of the service. As I have said, naval officers, like all other men, differ in their character and personality. There are some things which one officer can do very well, and there are other things which he can do but poorly. I venture to suggest that Lord Nelson could not make a watch, and I am really vain enough to think that I know as much about farming as did Farragut. Perry and Macdonough might have been poor lawyers, and some great sea captains would make poor bank presidents. In selecting officers, therefore, for important duties, it seems to me—as I say it is possible I am heretical in the matter—that the

primary consideration in the matter is their ability to fill their particular place, and all this with the highest regard to the essential qualifications of rank in a military establishment. The Secretary of the Navy is bound to pay the greatest heed to the recommendations and findings that come from officers selected for these manifold duties, either individually or as boards. In so far as he has personal knowledge of the men to be selected, can any greater task be imposed upon him than to make wise selections with full regard to the character of the special duty and the ability and fitness of the officer selected? In other walks of life men are not selected so much for availability as for fitness. Just because a lawyer happens to be doing nothing would not generally lead to his being selected for Chief Justice of the United States. The Secretary's duties under our system are much more onerous than under that prevalent in England. There, too, his responsibility is as great as here. But this responsibility is shared by the Board, or what might be called high court of appeals, which, in addition to its responsibilities, is also given a much larger field of discretion in the exercise of its powers than with us. The British system is characterized by two things: flexibility of operation and rapidity of action. Its source of power rests in the royal patent, and, singular to say, that while the wording of the patent has not been changed in hundreds of years, the system itself under it has been recast and remodeled often. By its silence Parliament has consented to the exercise of powers not strictly granted by the charter, and the whole system, which is very elastic, very adaptable, and under which the machinery is given full play and is totally lacking in rigidity, has grown up by accretions and experimental changes, and is based on experience. Our own system, by comparison, is more rigid and detailed, more given to the letter than the spirit. Of course, in some respects the British system would be entirely unsuited to our country and institutions. Our organization, with some changes and modifications, in the hands of an able administrator, would be better adapted for us than even the British system is for them.

Whether a certain naval organization is best or not can only be determined by confronting it with a crisis or an event in which the full play of the whole machinery has to be brought instantly into requisition. The useless, weak, and ill-adjusted parts will

then be sure to show themselves. The existing British system, within recent years, received a severe shock. On the very day that the Russian note presaging war reached Great Britain it was found instantly that changes in the naval administration to confront so grave a crisis would have to be made, and on the elastic terms of the patent such changes were immediately put in force. Then again, when the war-ship *Captain* foundered, the question as to who was responsible excited the whole of Great Britain, and the existing system was subjected to Parliamentary and other inquiries as to who was blameworthy for the improper building of that ship; in which case, by the way, you will remember, the court-martial decided that she was improperly built " in deference to public opinion expressed in Parliament," and against professional advice; a finding which seems to imply that a man might be a good orator in Congress and a very poor ship constructor. To locate responsibility, the British system aims at centralizing authority in the fewest number of individuals, and giving those the greatest scope of authority over those under them, and all parts of the machine at all times to be governed by the final decisions of the Board.

Our present naval administration, under existing laws, is well and wisely administered, so far as the Secretary of the Navy can control it, and yet I fully believe that in the event of war it would, of necessity, have to be changed and modified in many respects, both with regard to the efficiency of the personnel and matériel. In England the control of the personnel is subdivided under two or three Lords, each acting in his own sphere, but all are members of the Board of Admiralty. Under the existing conditions with us a tremendous amount of labor is thrown on the Secretary of the Navy by this side of the establishment, and while no one would advocate restricting his paramount authority, or lessening his responsibility, it is, I think, worthy of consideration, whether his professional advisers on this subject should not be increased and be subject to his own personal selection on coming into office. Under the British system the whole of the matériel is subject to the Controller of the Navy, who virtually regulates the actions of what would be equivalent to four of our bureaus, keeping them in touch and harmony in the work of constructing and equipping a completed ship. It is encouraging for those of us who believe that the present system can be made

more perfect, to note from Sir Vesey Hamilton's book that the reforms of grave and almost intolerable abuses, maladministration, and weaknesses in the British Navy were a work very slow in its accomplishment and gradual in its development, covering, indeed, a period of hundreds of years. The British system had at the start one great physical weakness in the scattered conditions of the offices relating to the Navy Department. These were scattered all over London, so that a man might travel a great deal if he had business with all the various officials of the Admiralty. With us, happily, the offices, with one or two exceptions, are in one building, and even these should have their headquarters there, so as to be in direct personal contact with the head of the Navy. I am not here to propose any radical remodeling of the existing system; for while, as I have said, I believe that it could be modified and improved so as to get the best results for the Navy and the country, I think that all work of change and reform should be gradual and normal, step by step, as experience indicated, innovations to be retained and made permanent only after fair trial and by the results attained. There is one thing certain: we have now reached that stage in naval development in this country when a proper and wise administration of the Navy and remedial legislation regarding the personnel are imperatively demanded. In the nice adjustments of the plans of power between the legislative and executive branches of the Government under our system it is not to be expected that the same wide range of discretion, the same exercise of broad powers, without recourse to legislative action, will be given to our executive officers as is done in Great Britain; and yet, under the laws as they are, very wide and proper discretionary power is lodged in the Secretary of the Navy; indeed, so much so, that when the former Secretary of the Navy, Mr. Whitney, presented a scheme of legislation for the consolidation of bureaus and a more centralized system of administration, it was argued by many in Congress that those powers already resided in the Secretary, and that no additional law was necessary. I think, however, that it would be wise if the Secretary of the Navy, on coming into office, could be given by law authority to call into his counsels, if he so desired, additional professional advisers, and so arrange the existing system that it could act with less friction, greater adaptability to circumstances, and produce quicker re-

sults, with possible economy to the Government. I think I am not misstating the case when I say that the great number of temporary boards called rapidly into being to pass upon manifold questions regarding the matériel and other questions shows that the Secretariate finds itself frequently in need of advisers near at hand to pass upon numerous professional questions demanding an immediate settlement. It is a question which I will not undertake to settle, or to pass upon, whether some one officer, such as a chief of matériel, or a board representing all branches of the service, such as an advisory board, should not at all times be close to the Secretary. It is not disparagement of the present excellent Board on Construction to point out what appears to be a weakness, and one which a lawyer would readily understand. It has been found, for instance, in most of our States that the court of last resort ought not to be composed of judges who go on circuit and try cases; that the community of individual interests among such judges, and the atmosphere of active litigation unsuit them for their higher functions or dispassionate consideration on appeal of abstract propositions. In Great Britain the Board of Admiralty, which is the supreme deliberative body, controlling and regulating the whole establishment, meets in session nearly every day. Under such a system as this, would it, or would it not, lessen the great number of advisory boards of investigation, courts of inquiry, courts-martial, and the distracting frictions and controversies of rival bureaus and their satellite appendages? This seems to me a question worthy of consideration. While most Secretaries of the Navy, very properly, do not court any additional responsibility by grant of Congress, and are more than willing that the legislative body shall take the full share of all responsibilities, still it is an open question whether it would not be wise to enlarge the Secretary's rights and powers with reference to the administrative methods of the Department. Rotation in office in Great Britain, which relates only to those highly placed, does not interfere with continuity of policy, and yet is sufficient to beget activity. I think you will all agree with me, that the present system of rotation among chiefs in the Navy Department has advantages over that prevailing in the War Department.

I have spoken now of the relations of the naval officer to the civilian head, and have suggested the wisdom of modification

of our existing system of naval administration. Before closing I wish to speak briefly of what, in my judgment, is a great national want. The defense of the United States against all foreign foes should be a unit, at least as to plan and preparation. There ought to be, and I am quite sure my friends of the Army will agree with me, a closer connection on this subject between the Army and Navy. The ship and fort are both essentials in national defense, and what are to be the functions of one and the other, as to what is to be the probable strength of the enemy, and the plans of defense against him, these two branches of the service should be in complete accord. I think every one will agree with me when I say that all the naval and military information should be, generally speaking, in common. I hope to see the time when there will be a board composed of army and navy officers, and called, say, "Board for the Military Defense of the United States." The present Board on Fortifications of the Army has lay representation, and this, if found advisable, could be added to this enlarged and more comprehensive board. Under such a board advising the President and Secretaries of War and the Navy, there would be a unification of arms and ammunition, perfect unity of purpose as to plans of defense, thorough harmony and co-operation as to the best policy regarding legislation, and a resultant enlightening of public opinion of which the country stands so sorely in need. So far as the Navy is concerned we have made a fair beginning in building up the matériel, but we are as yet far behind the needs of the nation, and I fear that the public are frequently misled by the high and just praises bestowed upon that which we already possess, into thinking that we are stronger than we really are in fact. The ships which we have built are excelled by none in the world; that we have constructed them under the difficulties and conditions that we did, seems almost miraculous. The guns, armor and ammunition have, admittedly, no superiors anywhere, but we have not enough of them. I cannot find language strong enough to condemn the criminal folly which leaves this nation practically unarmed. In the face of portentous happenings and dire possibilities, we are practically without any stores of small arms, and have no spare guns in the Navy, and a very limited supply of projectiles. In the question of small arms there should be in this country, beyond those necessary to arm all existing

military organizations, both the Army, Navy and Militia, a surplus supply of at least one million modern rifles, capable of being instantly put in the hands of the citizen soldiery. These small arms cannot be manufactured in a day, or a month, and when war comes it comes suddenly. Not long ago a distinguished and patriotic Senator, speaking to me, said that in a certain crisis ten million armed men would follow the flag. I might have said to him that we did not have rifles sufficient to arm one-fortieth of them. I am criticising no one either in the Army or Navy, but I think the facts speak for themselves, and I am quite sure if the people of the country were once thoroughly alive to the situation and its possibilities, that they would demand that measures be taken to create a proper supply of arms. No one can possibly object to this, not even my good friends who expect the millennium by an act of Congress or governmental treaties. These stored arms would of themselves be as inoffensive as so many volumes containing the annals of Arcadia.

I am glad to say that the present Congress has made provisions for creating some surplus guns for the Navy. No work could be more timely and necessary. Many of the American powers on this hemisphere, both colonial and independent, are much better off in this respect than we are, some of them having recently laid in large additional stocks of modern rifles, rapid-fire guns, and guns of heavy caliber. The exact number of surplus rifles in the United States at present is totally inadequate to a ludicrous degree, to the number that would be required at the very first outbreak of war. It is a fact, too, not recognized by the public, and not sufficiently recognized by Congress, that there is no open market in which munitions of war can be purchased. A recent inquiry made by the Department developed the fact that in the whole of Europe there was but a ridiculously small number of rifles, rapid-fire guns and those of large caliber which could be purchased. And the same applies to projectiles, powder, and all the munitions of war. As far as I am informed at this moment, there is scarcely one gun of modern caliber which could be purchased in open market. The great nations of the world carry large surplus supplies, and all the arms and munitions of war manufactured within their own borders, either by themselves directly or through contract, are kept for their own use, so that if we should be opposed by a single nation with no

allies, and all other countries were friendly to us, it would be impossible for us, with the limited means at our command, to make such rapid arming as the situation would demand. The capacity to produce, too, is limited in the physical nature of things. The machinery for the manufacture of arms and ammunition has to be especially constructed, is of a very costly and delicate nature, and requires skill and experience to operate. It cannot be improvised. The armories, arsenals, and manufactories, under government control, have physical limitations already existing as to their capacity of production, and these, taxed to their utmost and employing every possible man, and operating every machine, would not be able to meet the reasonable demands of war, from the possibilities of which no nation is ever free, and we certainly no more than others. Great wealth, material and resources, immense population, extensive territory cannot overcome lack of military preparation, organization and method. If it were otherwise the Japan-China war would have had a different ending. Moreover, the whole mechanism for the production of military weapons, including ships and forts, has made rapid and startling advancement. The modern gun is an article of slow and careful manufacture, incapable of being constructed by rapid castings or being turned out in large numbers with great rapidity. The fine old wooden sailing frigate, with her crew formed to repel boarders from the enemy, is quite a different thing from the massive, powerful, complicated and slowly constructed battle-ship of modern times. We do not repel boarders now, but we have to look out for a more deadly enemy in the torpedo and the torpedo-boat. We cannot create battleships as they built gunboats on the Lakes during the war of 1812. These great machines are worlds within themselves, and comprise the whole sum of human knowledge with regard to mechanism, chemistry, and the highest attained scientific knowledge. When the united services of the Army and Navy are brought into thorough and more familiar conjunction, these and kindred subjects will be more readily impressed upon the public intelligence, and will more readily secure Executive and Congressional action.

In conclusion, let me say that, earnestly concerned for the success of the Navy, I do sincerely trust that those in whose hands its administration will be entrusted in the future will continue, as their predecessors of all parties in the past have done, to treat

the Navy as a national institution, far removed from all partisan and personal considerations, and entitled to a broad and catholic treatment on high national grounds. It is a great honor to have been concerned in the administration of an institution so deservedly popular and of such infinite value to the country. The Navy is a military organization, and while the military atmosphere would seem to be foreign to the spirit of republican institutions, yet every one will recognize that a war-ship, for instance, conducted as a little republic, would be about as efficient for the purpose for which it was created as an excursion steamer. While the military arm of the Government is to be strictly subordinated to the civil, yet it should always be remembered that the hereditary features of a military organization are, of necessity, if it is to be efficient, the same under all forms of government, and that undue outside interference with its details will emasculate and destroy its usefulness for the very purpose for which it is maintained. If the military machine is to reach a high standard, and be equal to any crisis, it must continue to be permeated by the proper spirit, discipline, customs, and traditions. Within certain limits it should be ungrudgingly allowed an isolation from undue interference without, so that under the guidance of able and skillful professional men it may reach its best development. The more efficient the Navy becomes, from a purely professional naval point of view, the less a citizen, however conservative, need fear its growth, for its essential and paramount principle is absolute and unquestioned obedience to the constitutional authority, the defense of the integrity of the Republic from without, the vindication of its dignities and rights abroad, the protection of our citizens, the extension of our commerce, the maintenance of our eminent position among the great nations, and, finally, the greatest assurance for permanent international peace, a peace founded on respect and marked by honor.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

SHRINKAGES (APPLYING CLAVARINO'S EQUATIONS).

By LIEUT. J. H. GLENNON, U. S. Navy.

Let R represent the radius of the bore, R' the radius of the surface of contact of a hoop or jacket with the cylindrical inner body (which may be either a simple tube or a compound tube put together in any way whatever, provided always that the modulus of elasticity is and remains constant throughout, and that the elastic strength of the metal is not at any place exceeded at present or at any future stage), and R'' the external radius of the hoop (which likewise may be simple or compound with the same proviso). Let P, P', and P'' represent any three simultaneous pressures that exist at these respective radii in the assembled gun.

By (13), Meigs-Ingersoll's Elastic Strength of Guns (1891) we have for the elongation of any radius r in the inner body (modulus of elasticity, E_1), caused by the pressures P and P',

$$\Delta r = \frac{r}{3E_1}\left[\frac{PR^2-P'R'^2}{R'^2-R^2} + \frac{4R'^2R^2(P-P')}{(R'^2-R^2)r^2}\right].$$

The extension or elongation of the exterior radius of this inner body (substituting R' for r) then is

$$\Delta R' = \frac{R'}{3E_1}\left[\frac{PR^2-P'R'^2}{R'^2-R^2} + \frac{4R^2(P-P')}{R'^2-R^2}\right] = \frac{R'}{3E_1}\left[\frac{5PR^2-4P'R^2-P'R'^2}{R'^2-R^2}\right]. \qquad \text{(a)}$$

The *compression* of the *diameter* is evidently the double of this with a negative sign, or

$$-2\Delta R' = -\frac{2R'}{3E_1}\left[\frac{5PR^2-4P'R^2-P'R'^2}{R'^2-R^2}\right]. \qquad \text{(b)}$$

Proceeding now to the hoop (modulus of elasticity, E_2); the elongation or extension of any radius r in its thickness is, by (13), Meigs-Ingersoll's Elastic Strength of Guns,

$$\Delta r = \frac{r}{3E_2}\left[\frac{P'R'^2 - P''R''^2}{R''^2 - R'^2} + \frac{4R''^2R'^2(P' - P'')}{(R''^2 - R'^2)r^2}\right].$$

The extension or elongation of the interior radius of the hoop (substituting R' for r) then is,

$$\Delta R' = \frac{R'}{3E_2}\left[\frac{P'R'^2 - P''R''^2}{R''^2 - R'^2} + \frac{4R''^2(P' - P'')}{R''^2 - R'^2}\right] \qquad \text{(c)}$$
$$= \frac{R'}{3E_2}\left[\frac{P'R'^2 + 4P'R''^2 - 5P''R''^2}{R''^2 - R'^2}\right].$$

The extension of the interior diameter of the hoop caused by the pressures P' and P'' then is,

$$2\Delta R' = \frac{2R'}{3E_2}\left[\frac{P'R'^2 + 4P'R''^2 - 5P''R''^2}{R''^2 - R'^2}\right]. \qquad \text{(d)}$$

The various simultaneous pressures that may occur in the bore, at the surface of contact, and outside the hoop simply move the surface of contact in or out. An increase in the compression of the exterior diameter of the inner body is accompanied therefore by an equal decrease in the extension of the inner diameter of the hoop (neglecting the very small, secondary, quantities caused by varying pressures upon the thin ring of metal whose thickness is half the shrinkage).

The shrinkage is the sum of the compression of the exterior diameter of the inner body and the extension of the interior diameter of the hoop (or jacket) and is (adding (b) and (d) and denoting the relative shrinkage or shrinkage per inch of diameter by ς),

$$2R'\varsigma = -\frac{2R'}{3E_1}\left[\frac{5PR^2 - 4P'R^2 - P'R'^2}{R'^2 - R^2}\right] \qquad \text{(e)}$$
$$+ \frac{2R'}{3E_1}\left[\frac{P'R'^2 + 4P'R''^2 - 5P''R''^2}{R''^2 - R'^2}\right].$$

This formula is true for any simultaneous pressures that may occur at the points indicated.

The shrinkage is most readily calculated by supposing the pressure in the bore to be the greatest the gun of given dimen-

sions and metal can stand, namely, the elastic strength of the gun. In calculating this, it is necessary to find the pressures at the various surfaces of contact. That is, using the book notation (Meigs-Ingersoll's Elastic Strength of Guns), in finding P_0, which acts at radius R_0 of the bore, we have had to find the pressures $P_1, P_2, P_3 \dots . P_n$, which occur simultaneously at the respective radii $R_1, R_2, R_3 \dots . R_n$.

Using these pressures and radii in (e), we have for the first shrinkage (assuming the modulus of elasticity constant throughout),

$$2R_1\varphi_1 = -\frac{2R_1}{3E}\left[\frac{5P_0R_0^2-4P_1R_0^2-P_1R_1^2}{R_1^2-R_0^2}\right] + \frac{2R_1}{3E}\left[\frac{P_1R_1^2+4P_1R_2^2-5P_2R_2^2}{R_2^2-R_1^2}\right];$$

for the second, $$2R_2\varphi_2 = -\frac{2R_2}{3E}\left[\frac{5P_0R_0^2-4P_2R_0^2-P_2R_2^2}{R_2^2-R_0^2}\right] + \frac{2R_2}{3E}\left[\frac{P_2R_2^2+4P_2R_3^2-5P_3R_3^2}{R_3^2-R_2^2}\right];$$

for the third, $$2R_3\varphi_3 = -\frac{2R_3}{3E}\left[\frac{5P_0R_0^2-4P_3R_0^2-P_3R_3^2}{R_3^2-R_0^2}\right] + \frac{2R_3}{3E}\left[\frac{P_3R_3^2+4P_3R_4^2-5P_4R_4^2}{R_4^2-R_3^2}\right];$$

for the n^{th}, $$2R_n\varphi_n = -\frac{2R_n}{3E}\left[\frac{5P_0R_0^2-4P_nR_0^2-P_nR_n^2}{R_n^2-R_0^2}\right] + \frac{2R_n}{3E}\left[\frac{P_nR_n^2+4P_nR_{n+1}^2-5P_{n+1}R_{n+1}^2}{R_{n+1}^2-R_n^2}\right]; \quad (f)$$

and, if the n^{th} is the last, making $P_{n+1} = 0$,

$$2R_n\varphi_n = -\frac{2R_n}{3E}\left[\frac{5P_0R_0^2-4P_nR_0^2-P_nR_n^2}{R_n^2-R_0^2}\right] + \frac{2R_n}{3E}\left[\frac{P_nR_n^2+4P_nR_{n+1}^2}{R_{n+1}^2-R_n^2}\right].$$

In calculating any shrinkage, say the n^{th}, if P_n is $(P_n)_\theta$ (that is, if this elastic strength is determined by the amount the inner circumference can stretch), the last term of the shrinkage is $2R_n\frac{\theta_n}{E}$; that is, the n^{th} shrinkage is

$$2R_n\varphi_n = -\frac{2R_n}{3E}\left[\frac{5P_0R_0^2-4P_nR_0^2-P_nR_n^2}{R_n^2-R_0^2}\right] + \frac{2R_n\theta_n}{E}.$$

If P_n is $(P_n)_p$ (that is, if this elastic strength is determined by the amount that the inner radius can be compressed), it is necessary to make the substitution in (f).

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE DUDLEY POWDER-PNEUMATIC GUN.

By HOWARD P. ELWELL, Associate Member U. S. Naval Institute.

Since the introduction of shell fire from the old smooth-bore guns the attention of ordnance officers and experts of every country has been constantly applied to the development of its effectiveness. Gunpowder was naturally first employed, but as the higher explosives were developed and became better known, unremitting efforts have been, and are now being made, toward obtaining some method by which they could be safely used in projectiles in order to obtain the object sought—destructive shell fire.

To obtain such results almost every conceivable scheme has been brought forward, involving either one or the other of two methods: first, of stowing the explosive by various means in specially contrived projectiles, the idea being to neutralize the effects of shock of discharge of the gun; or, second, by using some force other than ordinary gunpowder in the gun, which of itself would act gently instead of creating a shock on the projectile, thus insuring a safe discharge. An example of the first method would be the "Judson shell" and the means by which both the Army and Navy are able to load small quantities of gun-cotton and other explosives in projectiles fired from ordinary guns. A prominent example of the second method is the pneumatic gun, or "Zalinski dynamite gun," as it is more popularly known, where compressed air is used instead of powder.

In the first method the results obtained are much more effective than they would be with shells loaded simply with powder, but the weight of explosive used is necessarily, on account of the

shock to the projectile, but a very small proportion of the total weight of the shell.

The second method is by far the most effective, as in this case very large masses of the highest explosive may be safely fired.

The ability to project these quantities of explosives with perfect safety and fair accuracy, together with the certainty of explosion at will, either on contact or with slight delayed action, is unquestionably of the highest importance. Favorable testimony to this effect from accepted authorities is so abundant and cumulative as to need no additional weight. So important indeed were the results obtainable by this method that a number of these pneumatic guns have not only been constructed and installed as a part of the defensive scheme for several important harbors—New York and San Francisco among them—but a special vessel, the Vesuvius, was designed and built as a "dynamite cruiser," carrying three such guns.

Some years ago the successes of these guns seemed to warrant the belief that they would become an important adjunct to coast defenses, as well as fill an important though distinct office afloat. For the past year or two, however, less and less has been heard of dynamite guns, and while to those not having knowledge of the facts the cause is unknown, it is really easily explained.

Without doubt the results obtained from this gun are as desirable as ever, and this being so, why has not the type been further developed and utilized? There is but one true answer to this—on account of complication in the system. Ordinarily in thinking of the question one simply has in mind the term—pneumatic gun. If the gun were complete in itself, matters would be comparatively simple, and in absence of complication would prove an effective and valuable weapon. As a fact, however, the gun itself, in this case, is but a detail of the whole necessary accompanying system. Without a steam boiler it is inoperative, yet the very mention of a boiler in connection with a gun brings immediately to mind the above-mentioned complications, for between it and the gun itself there must be necessarily a complex arrangement of air compressors, accumulators, pipes, valves and accessories, all of which require expert knowledge not only to assemble, but to keep in order and to operate.

In spite of all this complication the resultant value of the scheme is so desirable that this government encouraged the plan

LOADING

until it has become apparent that the many necessary mechanical parts and accessories involved complicate the system to such an extent that it cannot be depended upon.

It is undoubtedly true, however, that any scheme by which such desirable results can be obtained, and which is simple in construction and operation, will meet with general favor.

It is believed, and tests so far seem to prove, that in the Dudley system we possess all the required features with an entire absence of complication. This gun is as simple as an ordinary gun. It is an entirely independent unit, depending upon no outside accessories whatever. It is served, loaded, aimed and fired precisely as an ordinary gun, yet the force of the powder charge is so gently applied and cushioned that projectiles loaded with 60 per cent. of their total weight of the most violent and sensitive explosive are safely thrown to ranges far outside the limits required of such a weapon.

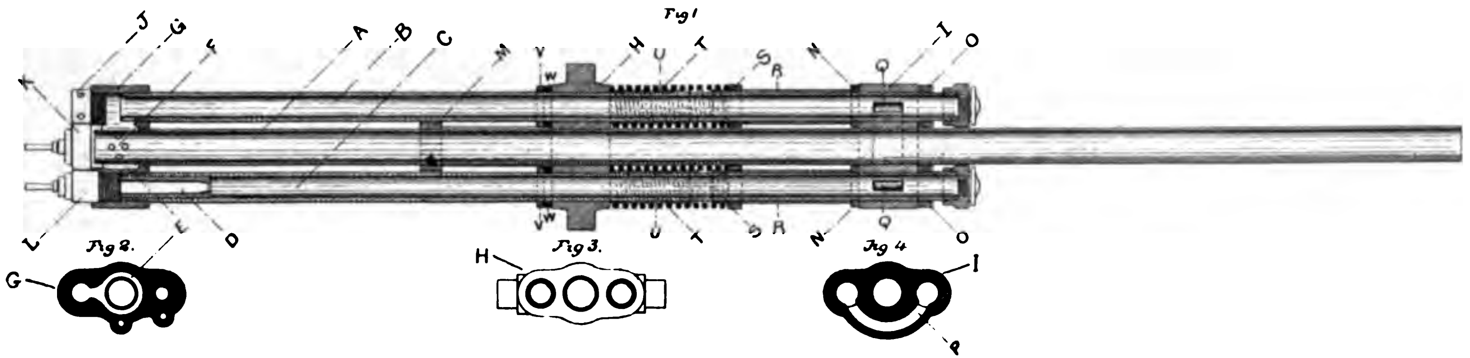
The description following is of a 4-inch gun, the subject of accompanying plates. A 6-inch gun would be on precisely the same design, an 8-inch gun practically the same with but slight changes in detail, but for 10-inch and larger calibers the design would have to be considerably modified.

The gun is built up of three tubes A, B, C (referring to Plate 7), placed side by side parallel to each other and in the same horizontal plane. The middle and longest tube is the main barrel. The two side tubes B and C together form an air chamber. The right-hand tube C is open at its rear end, in which is a steel bushing D chambered to receive a metallic cartridge case containing the powder charge. This tube is connected at its front end to the front end of the left-hand tube B, which in turn is connected at its rear end to an annular space E (Figs. 1 and 2) at rear end of main barrel. The main barrel has a number of holes F drilled through its walls connecting it directly with the annular space.

It will thus be seen that there is a clear, uninterrupted space between the powder charge and the projectile.

The tubes are held together and support each other by three gun-metal castings G, H, I (Figs. 1, 2, 3 and 4). The rear casting G is bored and threaded at its front end to receive the three tubes which are screwed in, forming pressure-tight joints in the case of the main and left-hand tubes. The rear of this casting

PLATE 7



CONSTRUCTION DRAWING.

is also bored and threaded in line with the tubes. A removable plug J is screwed pressure-tight at the left-hand. At the center a steel breech piece K, for the main breech mechanism, is screwed solidly to a shoulder. At the right is also a steel breech piece L for the side or powder mechanism.

The trunnion casting H is simply bored out to receive the three tubes, which are all fitted to slide freely longitudinally. To the rear of the trunnion casting is a small bronze casting M through which the main tube slides, as through the trunnion casting. It is fixed rigidly to the trunnion casting by four studs. and thus forms an additional guide for the tubes as they recoil, and also serves for attaching the elevating rack or screw.

The forward casting I is also bored for the three tubes. The main tube is fitted to simply slip into place, but has no fastening whatever at this point. The two side tubes being heavy and rigid in themselves support this casting and in turn support and stiffen the main tube, which, being much thinner, requires further support than given by the trunnion casting. The side tubes here have each two screw-collars, one at rear face of casting N, N, forming a shoulder, the other O, O, being screwed firmly against the forward face forms a pressure-tight joint, and also resists the full longitudinal strains of recoil. A port P (Fig. 4) is cored through the casting, passing under the main tube, connecting ports Q, Q, cut in the walls of the two side tubes.

A short piece of tubing R, R, having a screwed collar S, S, at one end, is slipped over each of the side tubes. One end abuts against the rear face of the collar, which forms a shoulder at rear of the forward casting. Between the screwed collar on the other end and the forward face of the trunnion casting is a spiral spring T, T, having sufficient resistance to compression to nearly absorb the recoil. Another short piece of tubing U, U, is slipped over the side tube under the spring, just forward of the trunnion casting, to limit the amount of recoil.

At the rear of the trunnion casting a collar V, V, is shrunk-locked to the side tubes, and between it and the casting a rubber ring W, W, is interposed to cushion the counter-recoil.

The side tubes are of 3-inch double extra strong commercial wrought-iron tubing. The construction as described is such that all longitudinal strains are taken by them. The main tube is of drawn brass, and being secured at one end only, is free to expand or contract, but is entirely free of all but bursting strains.

SIGHTING.

The side tubes are each provided with removable caps at the forward ends. These being removed, the plug at J and the two breech mechanisms being opened, the three tubes are clear for inspection and cleaning if found necessary.

The two breech mechanisms are of the slotted-screw type, the main provided with a gas check, that for the side or powder charge with hammer, mainspring, extractor, etc. Closing the block cocks the hammer, and a simple safety device is so arranged that it is impossible to fire until the block is completely locked.

The gun shown in the photographs is on a center-pivot carriage, but it is as readily mounted on a field or siege carriage for easy transportation, or on any other type of carriage, as it is entirely independent, the same as ordinary guns are.

On the mount shown the elevating and training gears are so arranged that the training shaft passes through the hollow elevating shaft, the two hand-wheels thus being on the same center, one just above the other. The shoulder piece attached to the left bracket of the carriage has a bearing for the shafts. The hand-wheels are thus brought so conveniently together that they may be worked by the left hand, while the right is free to hold and pull the lock lanyard.

The mount has otherwise no special features except the sight. This is so arranged that the directive element is entirely separated from that for elevation. A long bar, having a fixed front and a short vertically slotted rear sight-piece, is supported parallel to the axis of the gun, on one end by a rod to the trunnion bed of the carriage, the other at the shoulder-piece on a short slide adjustable at right angles, to provide correction for windage. These sight-pieces are fixed horizontally, so that the eye has the object constantly in view. The proper elevation is indicated by a range-bar, the lower end of which is attached to and recoils with the gun, the upper part sliding through a guide pivoted by the side of the rear sight to the shoulder-piece. This bar therefore moves vertically with the gun as it is elevated or depressed, the exact elevation being at once indicated by graduations on the bar reading against the top of its guide.

The whole sight thus becomes automatic, that is, no setting is required, the elevation or any alteration being coincidently shown by the range-bar, the direction of target being constantly in view through the sight-pieces.

BREECH MECHANISM OPEN.

The standard weight of projectile finally adopted for this caliber is 32 pounds. The powder chamber is reamed for 3-pdr. rapid-fire cartridge cases, in which 14 oz. smokeless powder, as manufactured by Dupont for the 3.20 Army field gun, is burned. Other powders may be used, however.

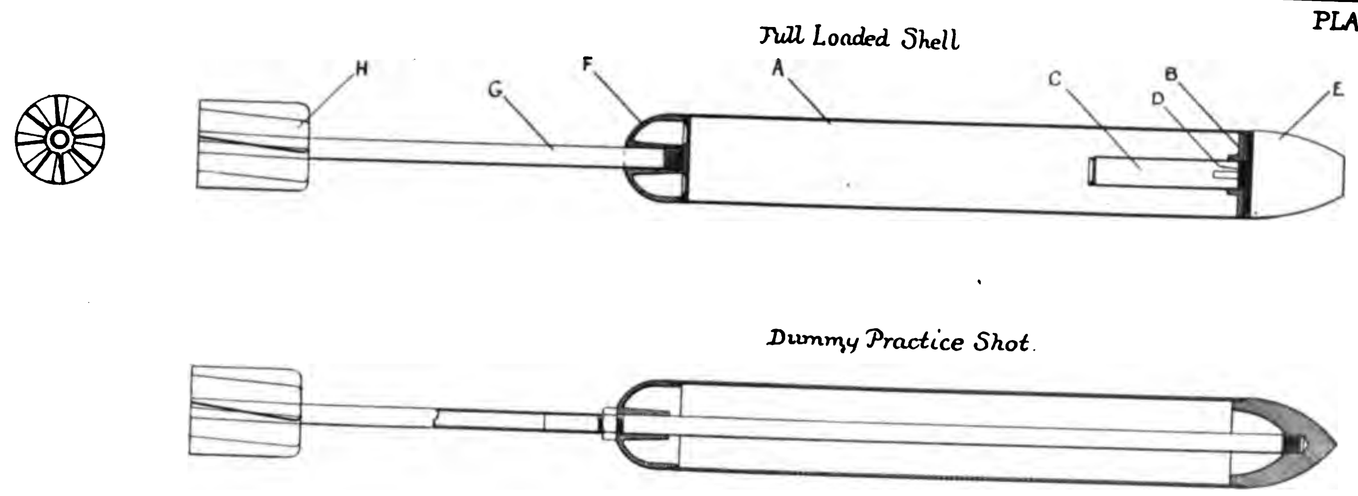
The body of the projectile (A, Plate 8) is of solid drawn brass, 4 inches outside diameter, No. 14 gauge, 26 inches long. The cylinder is threaded at each end on the inside for $\frac{5}{8}$ inch. A brass cap B having an internal thread is screwed in the front end to a shoulder. At the center of this cap is a thin brass tube C, $1\frac{1}{4}$ inches diameter, 7 inches long, projecting into the body of the projectile to receive the charge of dry gun-cotton. The inside of the front end of this small tube is threaded to receive a small cap-piece D containing the primer of 30 grains of fulminate. The head E of brass, constituting the body and containing the details of the safety fuze, is screwed into the cap. The body of the projectile is entirely filled with the explosive. The base F is an aluminum casting screwed into the rear of the tube. A tail-rod G of $\frac{7}{8}$-inch steel tubing is rigidly secured to the base and projects 18 inches to the rear, where a vane-piece H, of cast aluminum, is secured. This vane-piece has eight spiral vanes at a pitch angle of one turn in 84 inches.

The weight of charge is 13 pounds, and may be of any explosive now known. Explosive gelatine containing 92 per cent. nitroglycerine has been repeatedly and successfully fired. There seems to be an almost utter absence of shock on the projectile, the force being applied more in the nature of a vigorous push rather than a blow.

The heat developed is not sufficient to be taken into consideration. After rapidly repeating shots, an ordinary tallow candle, slipped into a thin brass cup fixed in front of the gas-check in the main bore, shows no sign of melting. In fact, the bare hand can hardly note the increase of temperature on the inside of the bore immediately after firing.

The gun is remarkably uniform in action, and can be depended upon to group the projectiles within an exceedingly small space. The report of discharge is peculiar—not sharp, but rather muffled, and is actually so slight that a shot-gun can be heard much farther. There is absolutely an entire absence of smoke or vapor of any kind. There is no flame whatever in sight, and at night it can be repeatedly fired without exposing its position.

PLATE 8.



PROJECTILES.

By no means is it expected that this gun or system will replace any gun or weapon now in standard use, but it is believed that it has a definite place of its own and will be found valuable in certain cases where there seems to be at present nothing to fill the requirements.

Without entering upon any argument, a number of instances will simply be cited as examples where this gun would be found invaluable.

Afloat.

At the present time the only means of offense of torpedo-boats is the automobile torpedo. True, they are supplied with a number of small rapid-fire guns, but these are simply for defense against small-boat attack, signaling, etc. The very construction of such craft prohibits the mounting of ordinary guns of sufficient caliber to be useful for attack, not only on account of the weight, but for the reason that the shock of recoil on the deck would be much too great for vessels of this type.

At present, then, the effective fighting range of torpedo-boats is limited to the range of automobile torpedoes, or, in other words, assuming the boats to be armed with the largest and longest range torpedoes developed to date, something less than 800 yards.

A moment's thought will indicate the great increase of effectiveness of boats of this class that would result from the mounting of guns capable of throwing large charges of high explosive for distances of say 3500 yards, supplementing their automobiles.

To be more explicit, let us assume that boats of the 6, 7 and 8 class now building, boats of about 180 tons, were each provided, in addition to their designed outfit of torpedoes and 1-pdr. guns, with two 6-inch powder-pneumatic guns.

As now designed, when within 800 yards of the vessel to be attacked, either while approaching for the attack or while attempting to get away after having launched (unsuccessfully) their torpedoes, the boats would be absolutely powerless. With 6-inch guns of this type, however, they would be able to show fight up to 3500 yards, either while approaching to torpedo (if discovered) or while attempting to get away. Assuming such boats to have under these circumstances a speed of 25 knots, the time required to cover the distance between the range of guns and that of torpedoes would be three minutes, during which time it would be

BREECH MECHANISM CLOSED.

possible to throw from the two guns at least 20 shots, each containing 50 pounds of the highest explosive. The probable chances of destructive effect from such a hail of bursting explosive can readily be conceived.

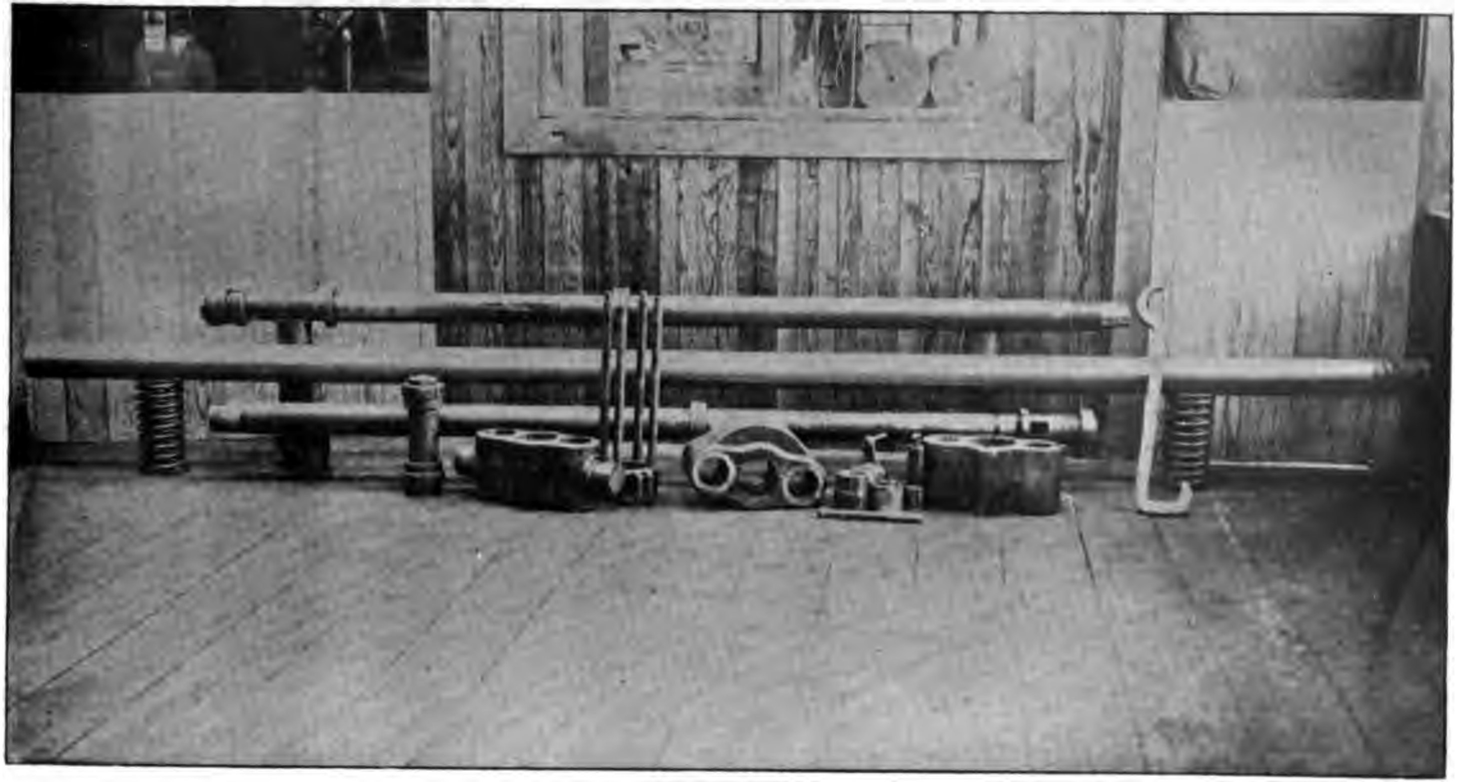
For countermining it is believed that this gun would prove particularly valuable, and far more effective than any known device; for this purpose, if for no other reason, one at least should find its place on every war vessel. When approaching waters where there is reason to believe that there are fixed mines, it will be possible by ahead fire to effectually clear the passage, destroying such mines by using shells fuzed for delayed action.

For auxiliary vessels, such as merchant craft, steam yachts, etc., that are likely to be pressed into service in case of an emergency, a battery of these guns would create a fighting strength far beyond that obtainable with any other type of gun that could be mounted on such craft. In this connection the light weight and absence of violent recoil would permit their being mounted without the necessity of strengthening decks, which would be absolutely required in mounting other guns, even of light caliber. The equipment of such vessels would thus be greatly facilitated.

ASHORE.

The gun has evidently an important place in coast defenses both in large and small calibers. The great advantage in this case is economy, as well as effectiveness. There is no known weapon approaching its effectiveness which can be furnished and mounted ready for service for less than double the cost of one of these guns. It is an undoubted fact that no gun (excepting the so-called dynamite gun) is capable of throwing a shell so destructive in its effect in proportion to total weight. It is so simple in construction, and therefore so easily taken care of, with a positive surety of its being at all times in perfect condition for service, that but slight attention need be given it when once mounted. The slight report from these guns and the entire absence of smoke and flame would make it possible to mount them in exposed places, with little or no protection, and with but slight chances of their exact location becoming known to the enemy. Especially would this be the case during a night attack.

For siege work the lightness of the gun and mount is of great



GUN DISASSEMBLED.

importance. It is readily possible to construct say a 6-inch gun of steel, weighing not over 3000 pounds, which will throw a shell containing 50 pounds of explosive gelatine to a range of at least 4500 yards. For this purpose the ease with which it may be dismounted, separated, and reassembled in the field gives it a peculiar advantage. The weight of the heaviest piece of a 6-inch gun would be 950 pounds (of a 4-inch it is 260 pounds). The practicability of transporting such a gun to localities and positions where it would be impossible to take an ordinary gun of equivalent effectiveness is of evident value. One single wrench and sledge-hammer are the only tools necessary to take it apart and reassemble, each operation being easily performed within an hour.

The 4-inch gun described weighs complete 1300 pounds, its mount 750 pounds. The gun has been fired about 200 rounds with full charges. It has functioned perfectly in every particular, the recoil easy, the breech mechanisms have worked well, and whenever attempts have been made at target practice remarkable uniformity and accuracy have been attained. Pressures have been repeatedly measured, and at no time, using same weight projectile and powder charge, has there been a perceptible difference. The limit of available range has been 2300 yards, and whenever desired this has readily been reached and could have been exceeded.

A number of full charges of explosive gelatine and also of gun-cotton have been fired, although most of the experiments have been with either dummy projectiles or for testing fuzes, with shells loaded with small charges of sporting powder.

This being the first and only practical gun built on this system, the action of the powder and in fact the whole principle being out of the ordinary, it is not to be expected that the best attainable results have been reached. So far as smoothness, easy action, recoil, and uniform action of powder is concerned nothing better could be desired.

Range of course depends entirely on the *amount* of force exerted behind the projectile, and it will be seen that this can be increased simply by increasing the diameter of the side chambers, increasing the volume of air-space between powder [illegible] this volume will permit the burning [illegible] increasing the *maximum* pressure.

HEAVIEST PIECE OF GUN.

The volume of air and gases thus increased, it is apparent that the pressure will follow the projectile farther in the bore, giving greater initial velocity. It is regretted that a series of actual pressure tests along the side and main tubes has not been made, although it has been the intention to do so. Such tests will be made, however, at the first opportunity. It is believed that with this data it would be quite possible to so design a gun of this caliber that the range would be doubled without danger of increasing the pressure beyond a perfectly safe limit for projectiles loaded with the most sensitive explosive.

Altogether this trial gun has given great promise, and there can be no doubt that it has demonstrated its value as a practical weapon.

It will perhaps be interesting, and at least it is but just to the original inventor, to give a résumé of the development of the scheme and credit its origin where it belongs.

The inventor, Dana Dudley, who deserves whatever credit is due, worked on the principle of which he was clearly the discoverer for a number of years, but was without the means to develop it properly. He had, however, made a gun of 1½-inch steam-pipe, which gave promising results and proved its feasibility.

In 1888 the Hotchkiss Ordnance Co. acquired control of the Howell torpedo, and soon after made a contract with the Navy Department for a number, together with the necessary launching-tubes. As no practical design then existed for the tubes, the question suddenly became an important one. It was thought necessary to use compressed air for launching, but the pipes for this in addition to steam pipes for the motor would have added to the existing complication.

The writer, who was then with the company working on the development of the torpedo, accidentally heard that Mr. Dudley had some sort of an air-gun. By request, Mr. Dudley showed and fired the gun, when at once it was evident that the scheme was applicable for launching-tubes. A temporary affair was built, and proving entirely satisfactory, the launching gear as now used by the company exclusively, and installed on several vessels in the Navy, was at once developed. No change has been made or found necessary in the application of the principle to that purpose, and this success led the writer to a firm conviction

of its value as a gun for throwing high explosives, which was the original idea of the inventor. No opportunity presented itself for working out the scheme until the past year. Now that a start has been made and the principle demonstrated on a practical scale, it is believed possible, with encouragement, to quickly develop the system until it takes its place along with the well-established standard weapons—the gun, torpedo, and ram.

Since the above article was written an official test has been given of the 4-inch gun before General Miles, the Board of Ordnance and Fortification, and Commodore Sampson, Chief of Bureau of Ordnance, Navy Department.

At this test 5 shells, each loaded with 13 pounds of explosive gelatine, were fired to sea, a distance of about 1900 yards, and exploded. These shots were perfectly satisfactory in every respect to all present. They were all that could be desired, being straight, true, steady and uniform in flight. Unfortunately, just afterward, during the practice at a target, the main tube was ruptured by the explosion within the bore of a shell loaded with 5 pounds of blasting powder. This accident, while putting an abrupt close to the tests, did not in any way count against the gun, as it was due to circumstances in no way related to the action or principle of the system, but was clearly due to a faulty fuze exploding the charge; and the result, so far as destructive effects are concerned, would have been much greater even had the shell been in the bore of say one of the service steel guns. The fuze was not one of those employed in the explosive gelatine tests and which so thoroughly proved their safety qualities, but one of entirely different design, made with a view of simplifying the construction. It is hardly necessary to say that this fuze has been condemned for future use.

Accidents of this kind generally and naturally serve as a check to the development of a new scheme, but it should be remembered *that it was not the gun which exploded.* It was a shell in the bore, and there are numerous parallel cases with ordinary guns and with corresponding results on record.

It was simply unfortunate that the accident happened at this stage of development and under the circumstances.

DISCUSSION.

THE ORGANIZATION, TRAINING AND DISCIPLINE OF THE NAVY PERSONNEL AS VIEWED FROM THE SHIP. BY LIEUT. W. F. FULLAM, U. S. N. (See No. 77.)

P. A. Engineer WALTER F. WORTHINGTON, U. S. N.—I have read the essay under consideration with great interest, and think it fortunate for the service that discussions of this kind should take place before the Naval Institute rather than in the public prints.

The author is to be congratulated on handling this subject in such a calm and dispassionate manner, and the conclusions he arrives at agree closely with my own in a number of particulars. His frankness and plain-spoken manner encourage me to believe that a similar frank criticism on points where we differ will not be taken amiss.

With regard to promotion by selection, it is generally admitted to be desirable if practicable. It would be wholly practicable to have the selection done by a board of senior officers. These would not be influenced by personal feelings if there was a general system of holding each senior officer strictly responsible for the work of his junior. Self-interest would compel him to select for promotion those found most successful in accomplishing the work assigned them. That system works well in the selection of enlisted men for promotions to positions as petty officers. Petty officers so selected on one ship are generally found to give satisfaction on other ships.

With regard to the statement that "there are too many line officers afloat," he says that it has proceeded from careless consideration, ignorance or malice. I maintain that the statement may have been made after careful consideration, in perfect good faith and with the best of motives. In the first place, the English ships, class for class, carry fewer line officers than ours and are well organized and efficient. In the second place, there are many line officers in our Navy who freely state that the deck watches in port and many minor drills and duties now performed by commissioned officers could be performed by warrant officers, as they are in the English navy. Thirdly, if enlisted men could hope to do more responsible duties they would be encouraged and more likely to reach that higher state of efficiency which the essayist himself justly says is so desirable.

It may well be that the presence of so many line officers on shipboard leaves too little duty to be entrusted to the petty officers. The constant presence of a commissioned officer on deck may make the petty officer feel that he is not trusted. To this cause more than to the presence of the marine sentry may be due that feeling of irresponsibility which we all deplore in our petty officers.

With regard to the necessity for so many officers to control the guns in different compartments, we who spend half our lives at sea know very well that the working of a modern gun is quite within the comprehension of a warrant officer, and the thought that by working it well in action he could get a commission would, in my opinion, be a sufficient stimulus to the patriotism which warrant officers possess as well as others.

It would be a bad system to maintain in time of peace a large force of officers to supply the needs of war. The Navy for the last twenty years has had an excessive number of officers compared with the number of ships, and we all know, and have all heard officers acknowledge, how rusty they get for lack of sufficient sea service. The enlisted men must be trained up to fill vacancies caused by war, and the naval militia developed to the utmost for the same purpose.

The essayist appears to me to confound two problems: one, to work a ship with the present inefficient petty officers, and the other, to work a ship with efficient petty officers.

The real function of the highly trained and educated officers graduated from the Naval Academy is to act as instructors and directors of the work of the higher grades of petty officers, who in turn should be required to instruct and control those below them, and so on. It is a waste of good material to have educated officers teaching the rudiments of ship's duties to landsmen and to personally supervise such work as sweeping decks. It is a singular thing that all this did not occur to the essayist, who has given so much thought to the subject of reducing the number of staff officers. If the system of turning over the bulk of the duties of the ship to petty and warrant officers was found efficient and advantageous, it would undoubtedly be adopted in the engine department, for the conditions are closely analogous.

Under existing conditions the system would be more likely to succeed with the line branch of the service than in the engine department, for the reason that in the former branch a large proportion of the petty officers have had years of training in naval vessels, whereas in the engine department by far the larger proportion of the higher grades of petty officers are taken in directly from civil life. For example, one ship was recently commissioned and sent immediately out to a foreign station. Three-fourths of the machinists provided to take charge of engine-room watches had never done such duty or served in the Navy before, and two-thirds of the water-tenders assigned to take charge of the watches in the fire-room had never been to sea before. This state of affairs prevails to such an extent in the engine departments of our ships that it is daily becoming more common for chief engineers, men of high standing for professional ability, to be punished for neglect of duty or sent directly from their ships to hospitals.

In the general shaking up which would be caused by these changes we must not forget that the highly educated and trained graduate of the Naval Academy, line or engine division, needs some additional practical training on shipboard, and must have one cruise at least as officer of deck or engineer of the watch.

The essayist's general idea of increasing the number of enlisted men who can reach the grade of warrant officer is good, and commissioned officers should make up their minds to accept a smaller proportion of the living space of a ship.

The idea of rewarding deserving men by giving them tours of shore duty at navy-yards is excellent. It would also have a fine effect on the enlisted men if they could think that the officers of a ship were going to look out for their welfare after the cruise was over. All the different grades of men in the engineer's force could be employed in work at the navy-yards, with advantage to the Government as well as to the men.

The principal objection urged against the marines is that they are not available to swell the numbers when all hands are called upon for special work, such as coaling ship, cleaning up after coaling, scraping bottom in dock, etc.

Outside of the United States the usual system is to pay for the coal to be delivered at the bunker scuttles. The coal merchants are always able to supply any number of laborers at a low cost. This system can be perfectly well adopted in the United States.

The best way to hoist coal aboard is with steam winches. Where on small ships they are not already fitted, they could be provided at little expense. The deck force then would have only the work of shoveling coal into the bunkers. This they can easily do faster than the engineer's force can stow it. Any dry dock can supply laborers to scrape the ship's bottom, and it would be cheaper to hire them twice a year for this purpose than to carry seamen whose wages would be double that of marines. With regard to cleaning ship, the deck force ought to be willing to do the whole of it, since their other duties have been so much lightened by the habitual use of steam launches in place of pulling boats, steam capstan, winches, etc., and the total abolition of all sail and spar drill and work about the sails and rigging. Merchant passenger steamers are kept clean with a much smaller force than is available on naval vessels.

Taking the foregoing facts into consideration, it would be a wasteful expenditure of money to hire seamen to do the duty now done well by marines and at one-half the cost. The marine officer is the logical consequence of the marine. Men develop best under officers who are not opposed to their presence on shipboard. If a marine officer is not fully occupied it is not because there is lack of work on a ship which he is quite competent to do.

Taking a general survey of the whole field, it is manifest that the system in the Navy for years past has been to avoid giving work to staff officers which they are perfectly competent to do, and to continually increase the duties of line officers, then to argue that the former are not needed and the latter overworked. It is always better to accomplish ends by a change of administration than a change of organization.

Having already trespassed so much on the space in the Journal, these remarks must be brought to a close without touching on many other

interesting points brought out by the essayist. I hope my silence will not be construed to mean either assent or dissent in these cases.

Lieutenant W. F. FULLAM, U. S. N.—The statements that the essayist —"a young man of no experience"—has been "unjust and unfair," has not been "honest," has shown "ignorance" and "an absolute lack of logic," and has appealed to "perverted facts" in treating the subject of naval reorganization "as viewed from the ship," may well be passed over with a good-natured smile in view of the many favorable comments by officers whose rank and experience entitle them, at least, to respect and courtesy in the discussion of a professional subject. And many personal letters from officers of all grades from admiral down, who for certain reasons preferred not to express their opinions publicly, might be offered by the essayist in further support of his arguments.

It is not surprising that some officers of limited opportunities for observation should fail to realize how small is the available working force in a modern ship's complement owing to absentees, vacancies, berth-deck cooks, the sick, and other causes. Such officers should not insinuate, however, that the executive excuses men who ought to work; and still less ought they to treat the matter with contempt and advocate that petty officers ranking with sergeants in the Army shall shovel coal while privates remain idle. When certain graduates of the Naval Academy state that the bluejacket has "barely enough drill and routine work to keep him from growling," and that we now have quite enough men to coal and clean ship, as shown by the fact that six of the "*slowest* and *laziest* men on board a merchant ship hoisted in, wheeled forward, and dumped into the bunkers 70 tons of coal in six hours," it is demonstrated that line officers of the Navy must treat the subject of the working force more seriously, because somebody is badly mistaken.

If extra sentries are needed now in coaling ship, it can be stated that no sentries whatever would be needed if the petty officers of the Navy were given the status of non-commissioned officers in the Army. Cases are known where the marine guard was sent ashore for target practice while the ship was being coaled, because the commander did not deem its presence necessary, and perhaps an officer who suggests the necessity of extra sentries in coaling ship may remember such an instance in his own experience.

It will be perfectly fair to regard the ship as a "floating fort" if we apply to the enlisted men on board the same rules as regards trustworthiness and military discipline and development that obtain in a fort that does *not* float, and if we put on board the kind of men who are most useful in a fort that really *does* float—the men who can best keep it afloat.

Conduct, court-martials and desertions should not be urged against the bluejacket, because in these particulars he shows up better than the marine. During a recent year the percentage of marines court-martialed was six times as great as that of bluejackets. During ten years, from 1882 to 1891 inclusive, *twenty-six per cent. of the entire marine corps*

deserted annually, and the total number of casualties was so great that the average term of service was less than two and one-half years.

It is not fair to the bluejacket to say that "naval history demonstrates the statement" that marines are necessary as a "rallying point in case of temporary break or disaster." Such was not the case at Fort Fisher, nor at other places where bluejackets have faced the enemy on shore. The latter, with the line officers, have always been well to the front—they have not been dependent upon the marines as regards "strategy" and "fire discipline."

To say that a "good sailor would be spoiled in making a poor marine" would be less correct than to say that a good marine would be spoiled in the vain attempt to make a good all-around man-of-war's man. The marine must be taught at least ten times as much as the bluejacket to bring him to the same condition of usefulness afloat. In some respects little is gained in the attempt to extend the field of the marine. For instance, the latter may be exercised in pulling boats, but the bluejacket usually hoists the boat in and out of its cradle and is given extra work in order that the marine may get an exercise, which, so far as it affects the efficiency of the ship, amounts to little more than play.

To say that the marine officer performs all the duties of a line officer, "except standing watch," may provoke a smile. The watch duty amounts to about five hours a day—it goes on like the brook, forever, night and day. But it is safe to say that, counting Saturdays and Sundays, the daily routine duties of a marine officer as "quartermaster," "ordnance officer," "officer of the guard," and "in charge of government property," do not occupy him more than two hours a day, and usually not more than one.

Foreign navies furnish more arguments against than in favor of marines afloat. England is about the only country that maintains a distinct and differently uniformed marine corps afloat. Her extensive foreign possessions make such a plan more reasonable. Many other nations have no marines at all, and the French "fusiliers" are seamen, uniformed and trained as such, who are given a little extra musketry instruction on shore. They are far more like our bluejackets than like our marines, and the officers in charge of them are line officers of the navy. It is ventured that they are in no sense superior to our bluejackets with the rifle nor at infantry drill. The French navy cannot be cited in support of the plan of maintaining soldiers on board ship.

And one of the English officers who is quoted by our marine officers speaks as follows: "My idea is that our marines should be analogous to this corps (the French fusiliers), and the officers take similar duties. Their naval training would also enable them *to be utilized for other work on board*. Instructed in navigation, and having taken part in the general routine of a ship, they would be qualified to take charge of a watch. *Their uniform should be adapted to the distinctively naval functions they would assume*. It is now purely military, ***an innovation which is comparatively modern***."

Plainly this officer advocates the French system, in which the marines

have practically become bluejackets. And still another distinguished English captain states: "*There is now no reason at all for employing on board ship men brought up and instructed as land forces, and yet such is the result of the present system of the training and discipline of the marines.*" In this we see in the English navy, as in all others, a decided tendency toward that "homogeneity" which a graduate of the Naval Academy declares to be a "snare and a delusion"! The proposition, therefore, to give the bluejackets and petty officers all military responsibilities and duties afloat is not only in accordance with the practice in most foreign navies, but it is only a short step in advance of the policy proposed by the most progressive officers of the English navy. Our own admirals and captains are fast reaching the same conclusion. An admiral writes: "It is now as absurd to employ marines afloat as to employ bluejackets as a guard in a marine barracks." A captain who did not take part in this discussion says: "I formerly advocated marines, but my experience in this ship convinces me that they are now entirely out of place in a modern fighting ship." This is a result of a practical study of ship efficiency.

In concluding the discussion of the marine question, the writer regrets, sincerely, that there should be any ill-feeling engendered. But it is a matter of grave importance. No other so seriously affects the discipline and development of the bluejacket. Nothing so hinders the elevation of the man-of-war's man and tends so directly to keep the profession of a seaman beneath that of a soldier. The most bothersome incidents in daily ship routine and discipline, from the time "all hands" are called in the morning—at work, at drill, when boats are called away, and when the ship is cleared for action—are usually traceable to the direct, the indirect, or the moral effects of employing marines on board an American man-of-war. It is not a fad nor a fancy; it is an ever present influence which an officer who carefully studies the men cannot fail to recognize. And it is only from a feeling of duty to his men and to the ship, and after an intelligent consideration of the conditions existing, *and the conditions that are to be desired* in the United States Navy, that line officers have been gradually forced to the conclusion that efficiency in time of peace and in time of war would be greatly increased by making the fighting force afloat perfectly homogeneous.

Mr. Worthington's criticisms are so courteous as to merit acknowledgment, and they may well be regarded as a model. In carefully avoiding personalities, his arguments come with additional force, and a rejoinder will be required to upset them.

Granting, most willingly, that Mr. Worthington, at least, is actuated by the "best of motives" in saying that we have "too many line officers afloat," it is submitted that statistics of our own and foreign navies, and considerations of *war efficiency*, will not sustain him in this opinion.

Counting available ships, there are ten line officers per ship in the United States Navy. The computation for the navies of England, France, Russia, Italy, Austria, and Germany shows an average of seven sea-going line officers per ship. In addition to these sea-going line

officers, however, there are, in these navies, 2890 officers employed on shore at naval schools, naval stations, and in hydrographic, coast survey and other work which is performed by the line officers of the United States Navy. Taking these into account, there are ten officers per ship—as many as in our Navy—employed in doing line officer's work in foreign navies.

Now, even if we regard the line officers employed in naval work on shore as a *reserve*, it may be shown that such a reserve, of all others, *is vitally necessary in our case.* With the addition of the proper number of torpedo-boats to our Navy—which is sure to come in the near future—and the assignment of *one* line officer to each of them, we would not have in time of war, when auxiliary cruisers are commissioned, more than five line officers per ship to meet an enemy! This will be too few, when we consider the work involved in quickly training a large number of recruits and in preparing to defend an extensive coast with scant material. With fewer ships, more raw recruits, and a more extensive coast than our probable enemy, we must not be caught with fewer trained officers. Economy, and every consideration based upon an intelligent study of the necessities of war, demand that the United States Navy should have at all times a surplus of line officers. A competent "general staff" assigned to the duty of preparing this country for the emergency of war would be sure to arrive at such a conclusion. At present the surplus, if such it may be called, is very small. If all the ships of the regular Navy were now commissioned, 75 per cent. of the line would be at sea. In time of war the officers of the retired list could do most of the shore duty; but, making all allowance for them and for available graduates of the Naval Academy now in civil life, the Navy would be hard up for line officers in the event of war.

England has fewer line officers than most other navies—too few in the opinion of many of the best authorities in England, one of whom speaks as follows:

"The want of fully trained lieutenants and sub-lieutenants is a *fatal one.* The whole greatness of a navy, *all probability of success in war* depends on a sufficiency of young officers of the highest class, and yet we have allowed ourselves to look forward with complacency to picking up a sufficiency anyhow. The thing has grown on us so gradually that we are unable to realize the condition. We cannot see the absurdity of the very high and expensive training we give to a *small number* of lieutenants, when, if war breaks out, we must place them *side by side with officers of no training at all!* Even for peace manœuvres *we are seen to run immediately short*, and we are placing warrant officers who may be fathers of families in charge of torpedo-boats. Without any disparagement, it must still be said that torpedo-boat service is not for warrant officers. If this weapon is to do what is expected of it, it can only be when it is in the hands of the young and the daring. There are a great number of ships *which ought for the sake of efficiency* to carry considerable numbers of sub-lieutenants, and which do not carry one."

This picture of the conditions existing in the British navy, where the number of line officers is admittedly too small, should be a warning to us.

I think Mr. Worthington is wrong in arguing that we should reduce the number of line officers in order to develop the petty officer, and I cannot admit that he and others have found an inconsistency in the essay regarding its treatment of this subject. The petty officer can be developed by giving him, without reservation, the *exact status of a non-commissioned officer*—"only this and nothing more." To deprive him of this status, and then seek his improvement by reducing the number of line officers, would be as absurd as to give a corporal the duty of a commissioned officer in the Army while denying his ability to act as sergeant of the guard. Instead, therefore, of withdrawing line officers from ships and depriving the Navy of those officers who would be most vitally necessary in time of war, we should withdraw other individuals who are not needed, and remove other obstacles that prevent the development of the petty officer *in his own legitimate field*.

Line officers will not complain of watch duty if they are freed from the duties that are usually assigned to the non-commissioned officers in an army.

Executive and watch officers, who have the best opportunities for observation, will not agree with Mr. Worthington that steam winches, steam cutters, and the abolition of sails and spars have lessened the burden of ship-work. The following comparison of the complements of the Wabash and Philadelphia will serve to illustrate this point:

	Tonnage.	Total Complement.	Deck Force.	Engineer Force.	Marines.
Wabash	4500	540	385	44	49
Philadelphia . . .	4300	368	161	90	36

From this it will be seen that the *deck force* of the Wabash was greater than the *total complement* of the Philadelphia. The deck force of the Philadelphia *is considerably less than one-half that of the Wabash*. Line officers who compare the new ships with the old, and who remember their experience in directing ship-work, know that, regardless of steam winches, etc., the burden of drudgery and coaling ship is far heavier upon the individual man than in former days. There are many more drills and exercises, and the line officer and bluejacket are kept far busier now than in the days of the "old Navy."

It is true that the "working of a modern gun is quite within the comprehension of a warrant officer"—or even of a petty officer, if we consider the *mechanical question* simply—and we may grant that these subordinate officers are equally patriotic also. But there are other than mechanical questions involved in the control of guns and in deciding whether commissioned, warrant, or petty officers shall be in sole charge in battle. If the commissioned officer can be dispensed with in *some* of the turrets and in *some* divisions without loss of fighting efficiency, he can, for similar reasons, be dispensed with in *all*. As stated by the English authority, it is absurd to have officers of a very "high and expensive training" working side by side with officers of no scientific training at all. One or the other must be more efficient in control of

the battery. Let us consider two exactly similar ships going into action, one in which highly trained line officers have charge of the gun divisions and torpedoes, and the other in which warrant or petty officers have charge. Which would have the best chance of success? If the latter, then the Naval Academy may be abolished with little loss to the Navy.

If the control and direction of guns and torpedoes against an enemy were purely a *mechanical* question, like the control of an engine for instance, it is admitted that practical men like warrant or petty officers could do the work as well as commissioned officers and graduates of the Naval Academy. But there are tactical and military principles involved which require the presence of commissioned, highly trained officers in each turret and gun division, for the same reason that such officers are required in a company and platoon of infantry. The presence of such officers does not prevent the development of their non-commissioned subordinates. With the utmost good nature it is submitted that, to use his own expression, Mr. Worthington "appears to confound two problems"—one to work a ship and develop efficient petty officers by withdrawing line officers from ships, and the other to work a ship and develop efficient petty officers without depriving the ship and the Navy of the officers who are most necessary to fighting efficiency in time of war.

Mr. Worthington criticises the proposition to reduce the number of staff officers and replace them by line officers when practicable, and advocates instead an extension of the duties of staff officers. It would appear that the former proposition simply takes account of ship efficiency —*naval* efficiency—and that the latter takes account,. primarily, of the *individual.* Now which is wisest and most economical from a naval point of view—to employ on board ship officers of no naval training and restricted usefulness, or officers of naval training and general usefulness? Which system would give the best results in time of war? All this *did* occur to the essayist when he proposed to replace officers and men of little or no naval training by others who are carefully trained. No offense was intended, no individual was to be injured—the "change of organization" was to be gradual, but it is absolutely necessary to the efficiency of the ship in time of war.

It is not easy to see that the plan of trusting petty officers on deck and withdrawing line officers would be more successful than to trust petty officers in the engine-room and reduce the number of scientific engineers, though Mr. Worthington seems to think so. It is submitted that the presence of so many commissioned engineers has prevented the petty officers in the engine-room from getting warrant rank. If petty officers and machinists in the engine-room have less service in the Navy than petty officers in the line, may it not be for the reason that they have less prospect for a warrant? Taking the five principal navies of Europe, we find that the average is 1.8 engineers per ship, while in our Navy the present number is 2.7 per ship, or as 2 to 3. We have, therefore, as large a surplus of engineers in our Navy as of line officers, in comparison with foreign navies. Is this surplus as necessary in the case of engineers

as in the case of line officers? Cannot the former be recruited from men in civil life more easily than the latter? Is it as difficult to find men who are acquainted with steam machinery as it is to find men who are acquainted with guns, torpedoes, naval tactics, etc.? There is nothing offensive in these questions, nor in the statement that the care and management of steam machinery does not require a distinctively naval training. It is only fair to say that the officers who run the engines of Atlantic liners and merchant steamers generally can run the engines of a man-of-war. Is it fair to say that the deck officers of a merchant steamer are competent to handle and direct guns, torpedoes and ships in a naval battle? Does not this duty require strictly naval training?

The same principles apply to petty officers—those who are to be efficient with guns and torpedoes must have naval training, while a machinist may be perfectly competent, as such, who has never seen a man-of-war. The same rule applies to engineers and machinists as to surgeons and apothecaries—all may be easily recruited from men in civil life.

It is to be regretted that Mr. Worthington did not give more space to the discussion of the engine-room personnel. It would be interesting to know if he advocates the increase of the engineer corps to 303, the assignment of engineers to colleges, and the appropriation of money to provide engineering plants for technological schools throughout the country in order that these institutions, probably thirty or more in number, might furnish about *seven* cadets annually for the Navy! Would it not be better to expend all this money and talent upon the Naval Academy course, where there is already a modern ship and some facilities for practical instruction, instead of attempting to build up thirty or forty schools of naval engineering? The writer believes that there are at least a few naval engineers who object to an increase of the corps which would sentence them to do the duty of a machinist for years, and that they would prefer a system in which the engine-room watch is stood by warrant officers and chief machinists, while the scientific engineers, few in number afloat, superintend the machinery. Line officers do not urge this plan on personal or corps grounds, or by reason of any feeling of jealousy or enmity. They, as the officers who must command the *whole ship*, believe that with the promise of warrant rank, shore service after a term of service afloat, and the retired list, a corps of most efficient mechanical engineers could be formed, thus relieving the college-bred engineer from the performance of duties that will always be uncongenial to him.

In conclusion, the writer insists that the essay was written with but one idea in view—to advocate what is best for the ship *as a man-of-war*. So far from being actuated by selfish motives, it is ventured that the watch officers of the Navy would, as a body, prefer to remain such all their lives rather than accept promotion as a result of compromises or measures that sacrifice the Navy as a military organization, and the ship as a fighting machine, in order to promote the interests of corps or individuals. We will continue to "plank the deck" and attend to every detail in ship routine rather than purchase advancement at such a cost.

Standing watch is an excellent thing in many ways; it keeps the "young" line officer in good physical trim and prevents his getting soft and flabby! In time of war he must have endurance. In time of peace he must prepare for war. Relieve him from a non-commissioned officer's duty and the line officer will attend to the watch and the legitimate duties of a commissioned officer.

The necessity for naval reorganization is pressing. It is annoying, to say the least, that the admirals commanding our most powerful squadrons, and the captains commanding our modern ships—even those within easy reach on the home coast—*should not even be consulted in framing measures affecting naval efficiency!* These officers, who study the whole problem of fighting efficiency—the only officers who do study it, the only ones who know about it—and who have kept these ships ready for war for months past, are ignored! The ship and the man who commands it are forgotten while "bills" are being framed in Washington! *But the ship and the man who commands it always decide the issue of battle.* They are not forgotten then. They should not be forgotten before the battle begins. If the Navy is to be reorganized in a manner to increase, *not lessen*, the chances of victory, Congress must think of the ship and respect the advice of the man in command, otherwise our Navy will be ruined by legislation.

Speed Control in Modern Steamers. (See No. 77.)

R. H. Thurston, Director Sibley College.—The general idea of Lieutenant Wood, as a matter of engineering, is, I have no doubt, perfectly feasible. I think that there is no serious difficulty in securing control of the speed, and of the operation of the engines, of a ship at any point on the vessel at which it may seem desirable. Difficulties will undoubtedly arise in the practical application of that scheme; but they will be overcome, it may be safely assumed, by a little ingenuity and skill in designing. In fact, the plan has been frequently proposed in the management of steam ferry-boats; where, if anywhere, that promptness of action and celerity of adaptation of the speed to the exigencies of the moment, which is important in the case of a naval steamer in battle, is most generally illustrated. There can be no question that the power of handling the ship and of adjusting her speed, as well as her course, from a point directly under the eye, and within reach of the voice, of the officer conning the ship, when in action, can hardly be overvalued. The real question and the fatal difficulties, if such exist, come in the actual employment of the device, which, as matter of engineering construction, may be, as we will assume, a perfect success. I am inclined to think, however, that it will be practicable to overcome all difficulties if the right sort of a designing engineer should take them in hand, and that none will prove fatal.

In the regular working of the engine, once started, and in simple adjustment of speed within ordinary ranges of working, I see no reason why it should not be perfectly practicable to secure the desired changes

from the pilot-house: always provided the proposed changes of speed are not too great and too sudden to be met, with similar promptness, in the boiler-room, and when no danger is incurred of provoking heavy priming, such as is liable to endanger the engines and disable the ship. The real obstacles lie in the facts that, as ordinarily handled, the engines and the boilers are under the eye and hand of people stationed where they can see every variation of the steam-gauge, every change of water-level, and every symptom of derangement at the boilers, as well as every indication of the presence of water at the engines, and who can, at all times and instantly, secure communication between engine and boiler-rooms and give any required premonitory message in case of trouble or danger arising in either engine or boiler-room. To make the plan here suggested a working and a safe arrangement, it must include a system of, probably oral, communication to and from the engine and boiler-rooms which will permit the commanding officer to give ample warning of intended evolutions, and which will permit the officers in the engine and the boiler-rooms to freely communicate both with each other and with the officer at the conning point. It will also involve the arrangement of a prompt-working provision for detaching the reversing gear of the engines from the control of the distant operator of the apparatus, so that, in an instant, if priming or other accident threatens, the men at the engines or the boilers may instantly meet the emergency by shutting off steam or momentarily slowing the engines, and thus avoid what might otherwise prove to be the cause of disability or of the destruction of the ship.

Throwing open the throttle-valve and giving the engines full steam at full stroke is not always certain to give the ship full speed; instant closing of throttle and shutting off steam completely will stop the engines, but it may not secure the appropriate synchronous action of the boilers. The ship's engines being stopped, the opening of the throttle is not always the only action demanded to start them, and it may destroy them the instant starting occurs. Starting heavy engines is always a matter of serious danger if intelligent caution does not preside on the occasion. Bringing engines to speed must be cautiously done, and any considerable and sudden increase of speed is liable to introduce danger of disablement at the engines, at the boilers, or at both. Overspeed, whatever the occasion, involves the same dangers. Sudden stopping usually involves no special danger in the engine-room; it may produce serious, even fatal, results in the fire-room when no provision is made for ample warning. The occurrence of a hot journal in the engine-room, if no provision is made for the officer there in charge instantly taking control on the arising of threatening emergencies of these kinds, may result in loss of the ship, and is very likely, in any event, to cause serious injury to the machinery, if not to destroy its efficiency for the time.

These are illustrations of the kinds of difficulty which may be experienced in the endeavor to reach the result aimed at by Lieut. Wood. It is very possible that they may delay the employment of his and other

devices of this nature; but I have myself no doubt that, if found by experience desirable, they will come into use.

As to mechanism, that has been already provided, and substantially as here proposed, many years. The steam steering-engine of Frederick Sickels, now more than a generation in use for that purpose, was also, in principle, applied by him to the handling of the valve-gearing of heavy engines, stopping, starting and adjusting speed as required, and at a date but little later than that of his first patent on that apparatus. It has precisely the same principles of construction in either case, has very similar duties, and may be relied upon without apprehension to supply the means of application of the system here discussed in every case. It has been employed in fact in all very large engines from his time to ours, and when embodying the essential features of the original invention, the plan is always found satisfactory. The connection of its operating valve with the conning-point is, to the engineer, hardly more difficult than running bell-wires. It is just such a bit of work. There is no more difficulty in connecting the steam reversing-gear than the steam steering-gear; the two machines are, kinematically, identical, and are simply slightly different applications of the same invention, substantially as proposed by that inventor. No serious uncertainty exists on this score. Lieut. Wood's remark about its practicability, and the illustration by reference to the locomotive, are perfectly correct. In fact, the P. R. R. used a steam reversing-gear under the hand of the engineman for large engines a long time ago. I am under the impression that the essential details of the scheme have been long since invented and patented, but I have not had time to investigate that matter.

Regarding the conclusions of this paper—the avoiding of accidents resulting from misunderstandings; the substitution of a better system for bells; the quick working of the engines and prompt adaptation of speeds to momentary requirements and emergencies; the control of the engines when minor accidents drive the people out of the engine-room; the adaptability to any form of engine; the easy transfer from the old to the new system, and the reverse; and minor advantages—all these advantages may, I think, be fairly claimed for a successful installation of this sort.

The quicker working of the main engines brings with it, as has been seen, some new and resultant risks. The relief of the engine-room officers from their present steady strain is perhaps likely to prove less than is anticipated. They must be ready at any instant, not perhaps to act in response to signals, but to detect those dangers which are entirely beyond the ken of the man at the distant operating point, and to jump at any instant to the reversing-gear for the purpose of disengaging the "automatic" action and checking priming or meeting other suddenly perceived dangers—dangers which would not be usually likely to arise under the present system, when the engines are handled by men whose eyes, and especially whose ears, are ready to warn them when they are approaching the limit of safe operation. I am not sure but that on this point the advantages lie with the existing system; but I do not think these advantages likely to control.

All things considered, as stated at the opening of this commentary, from the standpoint of the designing engineer, the problem seems to me simple, and in fact practically long since solved. It is about as easy to arrange for the handling of the engines, however heavy, from any point on deck as from the engine-room platform itself. The real difficulties will be found elsewhere. Sickels solved the engineering problem thirty or forty years ago.

HORACE SEE.—No question has ever been raised as to the possibility of devising some way to reverse the propeller engine and to regulate its throttle-valve at the bridge or in the pilot-house of a steam vessel. There is no doubt it can be effected in a number of ways with moderate success, but there are obstacles which, with our present knowledge, seem unsurmountable.

The reversing of the engine and the regulation of the throttle-valve are not one and the same thing. They are different functions which cannot be very satisfactorily performed at the same time by one instrument. If this could have been done it would no doubt have been adopted long ago in the engine-room.

The reference to the locomotive as an example is an unfortunate one. The engine-master of the locomotive of to-day does not have to move a massive lever in the cab. It is only necessary for him to move a small lever, and the reversing engine, as in the case of modern steamship engine, does the hard work. The regulation of the throttle-valve is also a separate operation. It will be found that the engine-master has one hand on the reversing lever whilst the other hand is on the throttle-valve. It will also be found that he does not move each at the same time, also that the speed of movement is not always the same. If such is the manner of governing an engine with the drains and other appliances convenient to the operator, how does it seem likely that a much more complicated piece of mechanism can be operated by a single lever located at a point where its movements cannot be seen and where the drains and other conveniences cannot be handled to suit the conditions which come under the varying pressures of steam, revolutions of engine, etc.?

When the engines are controlled at the bridge or in the pilot-house it will have to be in a manner very similar to that now employed in the engine-room.

PROFESSIONAL NOTES.

NOTES ON THE CARE OF RAPID-FIRE GUNS AND MOUNTS.

By LIEUT. JOHN M. ELLICOTT, U. S. Navy.

Several of the following methods having been successfully used by cadets at the U. S. Naval Academy under my instruction, and others having been suggested to me by officers who have applied them on board ship, I believe a description of them may prove useful.

OVERHAULING AND FILLING RECOIL CYLINDERS.

This should be done with great care before every target practice, or, if target practice is delayed, once a quarter; but if leakage is discovered at any time its repair should be immediate, and the cylinders should then be refilled.

Be sure that the filling end of the cylinder is not depressed.

An overflow from the filling hole is not a sure indication that a cylinder is full; neither is it safe to trust soundings with a rod, stick or straw. The liquid capacity of the cylinder of every gun should be ascertained and recorded. It would be well to stamp it upon the outside of the cylinder near the filling hole. This could be done as readily on board ship as in the shop. Before refilling, a cylinder should be drained, then the measured quantity of liquid it should contain ought to be gotten into it. If the full amount will not go in, there must be some foreign substance or an air cushion inside. If room is found for more than the registered quantity it is probable that the gun is not out to battery, or that a disc or spring has been left out in assembling, or that there is some leak.

The handle on the compressor screw for 4-inch cylinders is too short for sufficient leverage, and a monkey-wrench must usually be substituted. A ratchet-wrench with a handle about fifteen inches long should be furnished for the compressor screw-head.

TO RUN THE GUN IN AND CLEAN THE SLIDE RAILS.

This can readily be done, especially when the recoil cylinders are empty, and it should be done before target practice, or once a quarter, or after any exposure to sea or wet weather, in order to make sure that the gun is not " frozen " in its slide.

Pass the bight of a rope under the breech in rear of the recoil cylinder (4-in. R. F. G.), or in rear of counter-recoil cylinders (5-in. and 6-in. R. F. G's), and take the ends over the cap squares and, with round

turns, around the front transom of the oscillating slide, keeping free ends long enough for easing away. Remove one spring from the recoil cylinder (4-in. R. F. G's), or one spring from each counter-recoil cylinder (5-in. and 6-in. R. F. G's), and replace and set up pistons, rods and nuts. Depress the breech of the gun to full extent, ease away on the free ends of the rope and allow the gun to run in against the remaining counter-recoil springs. It may be necessary to start the gun with a pinch-bar or small tackle. Clean and lubricate the slide rails thus exposed.

The breech of the gun will now have too much preponderance to be raised by the elevating gear alone. Four men with the aid of a capstan-bar in the breech of a 4-inch gun, however, can raise it until sufficient muzzle depression is obtained to let the gun run out to battery. The friction discs of the elevating gear should be slacked off while this is being done, or the gear operated to assist in lifting. If the discs are slacked off they must be set up again as soon as the gun is out. More men may accomplish the same thing with the 5-inch gun, but with the 6-inch an overhead tackle or a jack may be necessary. After the gun is out, the muzzle should be kept depressed until the counter-recoil springs are replaced.

To Remove Rollers and Clean Roller Path, Training Rack and Trunnion Seats.

Remove clips, securing clamps and apron, replacing all bolts and screws with a slight turn in the holes from which taken. Ship the ratchet-wrench and jack up with it until the rollers can be removed. Block up under the chase and breech of the gun with sufficiently heavy material to bear its weight, taking care to place the blocks under the breech far enough back for the ratchet-wrench to swing clear. Remove the cap-square bolts and back out the cap squares. Slack the clamp of the elevating gear. Remove and clean the rollers; clean the path and training rack. Replace the rollers according to their numbers in their proper scores in the spacing rings. Ease down the top carriage with the ratchet-wrench, leaving the gun resting upon the blocking, until the trunnion seats are sufficiently exposed to clean them. Clean and lubricate the trunnions and seats. Jack up the carriage again with the ratchet-wrench until the weight of the gun is taken; replace the cap squares; remove the blocking; ease down the gun and carriage; replace apron, clips and securing clamps, and set up the elevating gear.

The ratchet-wrenches furnished for jacking up the top carriage have sometimes insufficient sweep between the carriage brackets and will not pawl. This can be remedied by heating and bending the wrench handles until they swing in the widest space between the carriage brackets. They then perform their duty admirably.

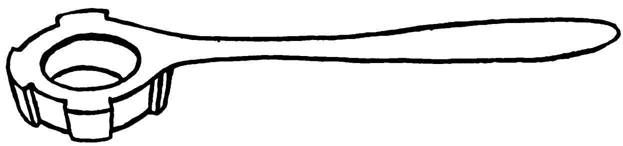
To Clean between the Gun and Recoil Cylinder.

With the 4-inch R. F. G., and with smaller calibers, the under surface of the gun lies so close to the upper surface of the recoil cylinder that moisture settles there and rust scale forms on the gun. When the gun screws into a sleeve it can be cleaned as follows:

Remove the sleeve-key set-screw and back out the sleeve-key. Unship the breech block. With a strap and heaver unscrew the gun a half

turn from its sleeve, bringing it bottom side up. Scrape, clean and repaint or repolish the exposed surface; screw the gun back again and replace the key and set-screw. Reship the breech block.

This is done to the 4-inch guns of the Essex without difficulty. By unscrewing the gun several turns and oiling the sleeve threads, it can be made to turn so easily that the gunner's mate can do it alone. Any ship's blacksmith could make a lever for this purpose having a socket bouching to fit into the screw-box, as shown in the sketch. With smaller rapid-fire guns a wooden heaver can be used in the breech block aperture.



To Overhaul the Training and Elevating Gear.

The chief precaution is to wedge pinions and worm wheels so that their slots are properly aligned for the keys on the spindles. Wooden mauls should be used in driving spindles home, or copper mauls as a last resort. The slightest burr or bruise should be filed from a key before it is replaced. When the vertical training spindle has been removed, with its pinion and bearings, it is well to remember that the training rack and much of the surface of the pivot stand is accessible through the hand-hole thus opened, if the gun is swung by hand through its full arc of training. In overhauling the training and elevating gear of the directing bar mounts for the 4-inch and 5-inch R. F. G's it is well to have their blue prints at hand until familiarity is attained, for their parts are so numerous and so combined as to be confusing.

To Sight the Firing Point of the Dashiell Breech Mechanism.

This is desirable when a miss-fire leads to the suspicion that the firing point is broken.

Open the breech; insert the blade of a screw-driver under the hook of the sear and bear outward, or hook the bight of a rope-yarn or of the lock-string under the sear hook and pull radially outward. At the same time pull the free end of the cocking lever away from the face of the block, and the firing point will be thrown forward and exposed. Press the cocking lever in, flush with the block again, before closing the breech.

What to do if the Dashiell Breech Block will not Unlock.

This may be due to a jammed cartridge case. See the breech fully closed, then insert the blade of a screw-driver between the projecting end of the extractor and the overhang of the breech-block rim, and press the extractor radially inward. Holding it thus, unlock and open the breech. The jammed case may then be removed by a hand extractor, or rammed out from the muzzle.

If this procedure does not permit the breech to be unlocked, the trouble will probably be found in the cocking mechanism. With the blade of a screw-driver between the sear hook and block rim, press the

sear outward as the hand lever of the block is drawn back, and the latter will usually revolve and swing clear. Then dismount the mechanism. The set-screw in the tapered nut behind the firing-pin sleeve will probably be found to lie in the wake of the sear partially unscrewed or with a burred head.

In "Description of Modern Ordnance" the sear is called the "releaser."

NEW DEVICE FOR SAILING SHIPS.

[The Steamship.]

An Italian sea captain is said to have made the extraordinary discovery that a ship goes faster when her sails are perforated with a number of holes than when they are quite sound. His theory was that the force of the wind cannot fairly take effect on an inflated sail because of the cushion of immovable air that fills up the hollow. To prevent this cushion collecting, he bored a number of holes in the sail, which let part of the wind blow right through, and allowed the remainder to strike directly against the canvas and exercise its full effect. Several trials have been made, and the results are so remarkable that it looks as if this is another of those paradoxical truths which appear so impossible on the surface. The experiments were made in all weathers. In a light wind a boat with ordinary sails made 4 knots, while with perforated sails she covered 5¼ knots; in a fresh breeze she did 7 knots with ordinary sails, and 8¾ knots with Captain Vasallo's invention; in a strong wind she did 8 knots and 10 knots respectively. If this increased speed were sustained throughout a long voyage it would increase the value of the ship one-fifth, as she would make the same trip in four weeks that she did before in five weeks.

THE BAZIN DISC WHEEL STEAMBOAT.

[The Engineer.]

Curiously enough, interest is being taken by French marine engineers in an experimental vessel now being constructed at the Saint-Denis Works of the Cail Company for a concern which was formed some time ago to work a so-called new system of propulsion of M. Ernest Bazin. It is hoped that this novel boat, which has already been in hand six months, will be launched in July next, and it will make its first trial trip across the Channel as soon after that date as possible. Writing on this subject, our Paris correspondent says: "Though at one time the *navire rouleur*, as it is called in France, met with a great deal of criticism among marine experts, who were rather sceptical as to the success of this new departure from the generally accepted ideas of naval design, it is significant that a fuller acquaintance of the theory laid down by M. Bazin has led them to place faith in the capabilities of the disc-wheel vessel. This theory is by no means a new one with M. Bazin, who has been working at it for twelve years or more, and an inspection of the models to be seen at his works at Levallois shows that the system has been applied in a great many different ways before the inventor was able to evolve the remarkable vessel which is now to be put to a prac-

tical test. It may be said that the first idea of M. Bazin was to apply a revolving motion to the vessel for the driving action in order to overcome the enormous waste of power due to the resistance of the water and the friction. As is well known, this resistance is proportional to the square of the speed of the vessel, and as the ratio of horse-power necessary to drive a ship increases enormously with the high speeds sought to be obtained, it is believed that the limit in the keel boats has almost been reached. In the problem which he has set himself to solve, M. Bazin believes he has suppressed the resistance of the water to the forward movement of the vessel, and in so doing he has not only added to the speed, but has secured, he says, great economy in motive power as well. To attain this end he designed a vessel in which a flat rectangular deck would be supported by hollow disc wheels of steel running upon their axes. Experiments were made to show the action of these wheels in the water, and in the presence of a large company they were repeated a few days ago by M. Bazin in a tank constructed for this purpose at his Levallois Works. First, a hollow wheel was placed in the tank, and it floated vertically with about a third of its bulk immersed. Spun round without any forward movement, the wheel continued to revolve for some time without moving from its place, and this proved to M. Bazin that he could not rely upon the revolution of the wheel alone for the propulsion of the vessel. He then pushed the wheel forward without revolving it, and the effect was exactly the same as with an ordinary keel, that is to say, it threw up a good deal of water in front and left a trail behind. Moreover, it only advanced four or five feet, and did not show the slightest tendency to revolve. This convinced M. Bazin that he would have to give to the wheel both revolving and a forward motion. Thereupon, spinning the wheel and pushing it forward, the hollow disc traveled the whole length of the tank with scarcely any agitation to the water whatever. Still pursuing the experiments, the inventor gave a more convincing illustration of the absence of any resistance and friction with the revolving disc. Two sticks were placed in the water, and a disc was propelled horizontally. On meeting the sticks the wheel pushed them forward a few inches and then stopped. Repeating this experiment with a revolving disc, the wheel passed over the sticks, which sank under the wheel and rose at the identical place, while the disc continued its course to the end of the tank. After thus proving that the wheel must have both a revolving and a forward movement, M. Bazin soon found that nothing was to be gained by revolving the disc too quickly, and that it was merely necessary to do this in proportion to the propelling force of the screw. If anything, too much power upon the wheels would be likely to cause a certain amount of friction. Under these circumstances, the relative power upon the propeller and the wheels would have to be calculated with a certain nicety, as the discs would have to turn in exact proportion to the distance covered by the boat. This fact having been settled, M. Bazin proceeded to demonstrate the stability and speed of the wheels. A framework carrying six disc wheels, three on each side, was placed in the tank. A cord was attached to it and drawn up over a pulley, and carried a weight of 200 grammes, which represented a certain propulsive force. The frame was pulled back to one end of the tank and allowed to go forward by the action of the weight at the end of the cord. According to the watch, the time occupied in traveling the whole length of the tank was twenty-three seconds. The same experi-

ment was then repeated with the wheels revolving by clockwork, and though losing two or three seconds at the start before getting up full speed, the apparatus went from one end of the tank to the other in eleven seconds. By comparing these results, M. Bazin estimates that the speed of a disc-wheel steamboat would be 31 or 32 knots, while the smaller power required results, according to his estimate, in an economy of about 66 per cent. of coal. One of the advantages claimed for the system is the practical impossibility of sinking. Supposing that one or two, or even more, of the wheels were perforated in collision, the vessel would not do more than sink a few feet, a fact which was exemplified by the inventor removing the plugs from two of the wheels and allowing the water to enter. As soon as the water had entered to a certain height in the wheel, it turned up with the orifice at the top, thus permitting of the damage being repaired with the greatest ease. Meanwhile, it would be possible for the vessel to proceed at reduced speed. Having thus, as he considers, demonstrated the speed, economy, stability, and safety of the Bazin wheels, the inventor showed a working model in a large basin constructed for that purpose. As the model is on a scale of one-twenty-fifth of a transatlantic boat, which it is proposed to build with a length of 130 m., the deck or platform represents a height of six or seven meters above the sea, while the upper deck is about 13 m. above the water-level. The deck itself is built up with girders, and being hollow, it has an enormous carrying capacity, either for merchandise or coal. There are eight discs or floats, four on each side, and owing to their convex form they offer little resistance to the wind, while the head wind has a clear passage underneath the deck. In appearance the model is very elegant, and certainly destroys any prejudice that might be entertained against the form of the vessel. The motive power was supplied by dynamos, one working the propeller and four others turning the floats. Upon the connection being made, the propeller revolved with great rapidity, and the wheels turned slowly, and after a few seconds lost in getting under way, the model sailed the whole length of the basin at great speed. To show the conduct of the vessel in rough weather, the water was agitated to represent waves, on the same scale as the model, of five to seven meters in height, and though rolling slightly at her moorings the model behaved splendidly when in motion. The miniature waves rose nearly to the level of the deck, but the model rode as steadily as in the previous experiments. It is claimed that in the roughest weather the passengers would feel very little movement of the vessel. In the experimental boat now being constructed the steering is done with an ordinary rudder, but it is proposed to steer the transatlantic vessels by means of a column of water forced out of the stern by a pump, so that instead of the progress of the vessel being impeded by the resistance of a rudder, it will be assisted by the water thus expelled at the stern. On the boat taking up its berth it may be driven by the steering gear alone, and this acts, it is alleged, so efficaciously that the vessel can be turned round in its own length.

"It may be added that Admiral Coulombeaud, one of the foremost naval authorities in France, is taking a keen interest in the Bazin disc-wheel boat, which he thinks is destined to effect great things in the water transport of the future. He admits having been sceptical as to the practicability of the system when it was first mooted, but after making a close study of the invention, he has fallen in with most of the ideas

enunciated by M. Bazin. After going to some pains in making a comparison between the *navire rouleur* and the ordinary keel boat, the Admiral has come to the conclusion that the Bazin boat requires only about twenty-seventh of the power necessary to drive an ordinary boat of the same size at a given speed. Taking the transatlantic Touraine as an example, he further states that if this vessel traveled at 20 knots, the disc-wheel boat, with the same horse-power, would attain a speed of 47 knots; but as it is not proposed as yet to construct a vessel to run at more than 30 knots, such a boat would only require a fourth of the power employed in the Touraine. His deductions also show that the power necessary for the floats is one-fourth of that employed for the propeller, and upon all the other points he is in accord with M. Parrot, professor of the Ecole Centrale, who has drawn up an exhaustive theory of the working of the Bazin boat. Admiral Coulombeaud does not believe that the present form of the disc-wheel boat is a permanent one. It will be greatly modified to suit the different conditions of transport, and this is especially the case with the floats, though for transatlantic vessels the present disc wheels could hardly be improved upon. The opinions thus expressed by some of the leading naval authorities in France give special importance to the trials that are to take place before long with the experimental vessel now being built, and if successful it is probable that a boat will be put in hand to run between Havre and New York. The following dimensions of the boat now building at the works of the Cail Co. may be interesting: Number of floats, 6; diameter of the floats, 10 m.; length of the boat, 39 m.; breadth, 12 m.; superficial area of the midship frame, about 50 m.; burden, 274 tons; power developed by the boiler, 700 horse-power, of which 550 horse-power will be upon the propeller and 150 horse-power on the axes of the floats. There will be a separate engine for the propeller and for each pair of disc wheels."

We have here history repeating itself. The boat on rollers is an invention as old as the steam engine.

TO PREVENT COLLISIONS AT SEA.

[ARMY AND NAVY REGISTER.]

There has been favorably reported to the Senate and House a bill to amend the act approved August 19, 1890, adopting regulations for preventing collisions at sea. A few days ago the American delegates to the recent International Marine Conference met in Washington to consider proposed changes in the rules of the road submitted by Great Britain to this Government. The American delegates regard the suggested modifications as satisfactory, and so reported to the Secretary of State. With the report they submitted a draft of a bill which the President has transmitted to Congress. It is this which is now before the Senate and House with a favorable report. The bill provides that Article 15 of the act mentioned shall be amended to read as follows:

Article 15. All signals prescribed by this article for vessels under way shall be given: first, by steam vessels on the whistle or siren; second, by sailing vessels and vessels towed, on a fog-horn. The words "prolonged blast" used in this article shall mean a blast of from four to six seconds' duration. A steam vessel shall be provided with an efficient whistle or siren, sounded by steam or by some substitute for steam, so placed that

the sound may not be intercepted by any obstruction, and with an efficient fog-horn to be sounded by mechanical means, and also with an efficient bell. (In all cases where the rules require a bell to be used, a drum may be substituted on board Turkish vessels, or a gong where such articles are used on board small sea-going vessels.) A sailing vessel of 20 tons gross tonnage or upward shall be provided with a similar fog-horn and bell.

In fog, mist, falling snow or heavy rainstorms, whether by day or night, the signals described in this article shall be used as follows, namely: (a) A steam vessel having way upon her shall sound, at intervals of not more than two minutes, a prolonged blast. (b) A steam vessel under way, but stopped, and having no way upon her, shall sound, at intervals of not more than two minutes, two prolonged blasts, with an interval of about one second between them. (c) A sailing vessel under way shall, at intervals of not more than one minute, when on the starboard tack one blast, when on the port tack two blasts in succession, and when with the wind abaft the beam three blasts in succession. (d) A vessel when at anchor shall, at intervals of not more than one minute, ring the bell rapidly for about five seconds. (e) A vessel when towing, a vessel employed in laying or in picking up a telegraph cable, and a vessel under way, which is unable to get out of the way of an approaching vessel through being not under command, or unable to manœuvre as required by the rules, shall, instead of the signals prescribed in subdivisions (a) and (c) of this article, at intervals of not more than two minutes, sound three blasts in succession, namely, one prolonged blast followed by two short blasts. A vessel towed may give this signal and she shall not give any other.

Sailing vessels and boats of less than 20 tons gross tonnage shall not be obliged to give the above-mentioned signals; but if they do not, they shall make some other efficient sound signal at intervals of not more than one minute.

Sec. 2. That said act of August 12, 1890, as amended, shall take effect at a subsequent time, to be fixed by the President by proclamation issued for that purpose.

WOUNDS BY THE BULLETS OF MODERN RIFLES.

[ARMY AND NAVY JOURNAL.]

Reports have been received at the War Department from military attachés of the United States abroad stating that in the Egyptian campaign the small-calibered steel-jacketed bullets from the high-powered rifles of the foreign troops fail to stop an enemy when he is struck. The failure in this connection is ascribed to the fact that the bullet, going with such high velocity, perforates quickly if it strikes a soft portion of the body, and for the time being does not sufficiently injure the wounded man to cause him to stop. Both the Navy small arm, just adopted for the naval service, and the Krag-Jorgensen rifle are of small caliber, the former of .236 and the latter of .30 caliber, and some army and navy experts have claimed that neither arm would be effective in instantaneously stopping an enemy unless he was struck in a vital spot. Brig. Gen. Flagler, Chief of the Bureau of Ordnance, has recognized that there might be something in this assertion, especially in view of the

results obtained abroad, and under his direction some experiments have been conducted with a view to securing a bullet which will stop an enemy if it strikes him. With the present style of bullet, the Krag-Jorgensen rifle can send a ball through three men at a thousand yards. With the change proposed, it will be impossible to obtain this penetration unless some improvement is found, which is being sought, which will give the same penetration as is now had. The change made consists in cutting away the steel point of the bullet so as to expose the lead core. It has been found that when a bullet so treated strikes an object it spreads out, and causes, consequently, a great deal more damage to the object struck than is now obtained with the bullet as it is now in service. Penetration is naturally required, and Gen. Flagler, in the experiments now being made, hopes to find some scheme by which the same penetration as was secured with the old bullet with greater destroying effects may be obtained.

Fort Riley, Kan., June 20.—An official test of the Krag-Jorgensen was made on dead bodies at post to-day under the direction of Dr. J. D. Griffith, of Kansas City, member of the United States Association of Military Surgeons and chairman of the National Committee on testing new guns, assisted by a dozen attending surgeons and photographers.

The object of the test was to find out the relative effects of the use of the Krag-Jorgensen gun, from a humanitarian point of view, as compared with other army rifles. This test has demonstrated to the minds of those who participated that the Krag-Jorgensen gun cannot be called a humane gun.

The three corpses to be experimented upon were placed side by side in an erect position just at the base of a hill, and a paper target was placed in front of each body to furnish a sight. Adjt. Scoll, 5th Cav., placed a detail of sharpshooters at a distance of 1000 yards, and then at 1500 yards. The firing was first by singles and then by volleys. Examinations of the bodies were made at intervals. Photographs were made of the wounds, showing as much as possible of their nature. The bodies were liberally perforated with bullets, nearly every organ and muscle being struck. Post-mortem examinations were made after the tests, and from them the following deductions were drawn:

At distances up to 1000 yards the explosive quality of the Krag-Jorgensen bullets, and consequently the cruelty of its use, is terrific. The explosive quality is most marked in soft tissues and cavities, the brain and lung tissues being terribly torn. When viscera are grazed by a bullet they are mutilated. Blood-vessels are cut, not torn; hence the death rate on the field will be very great—four killed to one wounded, probably. Tendons are the only tissues in the body which seem to be turned aside by the ball.

Further deductions drawn from experiments by firing into flesh and hard earth are as follows: Battles of the future will not be fought at artillery range. Any soldier can protect himself by the use of his bayonet as a pick. The best protection is loose, dry earth; next best, loose sand. Hard earth offers little resistance to bullets, which pass through from 16 to 20 inches of it practically without mutilation, whereas that many inches of fresh earth tear the bullet all to pieces.

ARMOR TESTS.

Test of an Experimental Turret.

[Army and Navy Journal.]

The experimental turret was tested at the Indian Head Proving Grounds on Saturday, May 9, and the results were in every way satisfactory. The test occurred in the presence of Secretary Herbert, chiefs of Bureaus of Navy Department and naval officers and members of the Congressional Naval Committees. The turret structure was almost identical with a turret on board the battle-ship Indiana. The ballistic plate employed was a 15-inch Harveyized nickel steel plate, manufactured at the Bethlehem Iron Works, put in position in that part of the turret that was to be fired at. Heavy cast-iron plates completed the turret, together with a heavy top. This armor plate had already been tested with two shots from a 10-inch gun.

The structure proper weighed 67 tons, the armor 157 tons, and there were inside of it 180 tons of pig metal to represent the guns, mounts, etc., a total of 404 tons. The whole was mounted on twenty radially placed cylindrical steel rollers, 10 inches in diameter and 30 inches long. Arrangements had been made for measuring any sliding, rotary or vertical motion of the structure. Before the first shot was fired at the improvised turret, a dog was placed within it to ascertain the effect the impact of a heavy shot had upon the inmates of the turret. The test was very severe, and was largely for the purpose of demonstrating whether the rollers on which the turrets are built would work satisfactorily under heavy shots, and also how the whole structure would withstand the shock. The structure withstood the impact of the heavy shells very well, and it is believed that heavy turrets, such as were represented to-day, will be all right under fire from heavy guns used in the Navy. It is feared, however, that the intermediate, or 8-inch turrets, would be disabled by shots from 13, 12, 10, or even an 8-inch gun, and it is possible that one shot from a 13-inch gun might knock such a turret over. The first shot was a Wheeler-Sterling shell, weighing 300 pounds, fired from a 10-inch gun, with a striking velocity of 1680 feet per second. It struck the plate 8 inches to the left of the normal line and 16 inches from the top. It penetrated 10 inches into the 15-inch plate and then broke up. The point of the shell welded into the impact. As a result of the impact the whole structure moved 1¾ inches to the rear in the line of fire. A triangular piece of plate weighing about 300 pounds was broken out above the impact. The supporting cast-iron plates were slightly wedged up. The turret seemed to be slightly sprung or elongated in the direction of the line of fire.

The second shot was fired from a 12-inch gun, a Wheeler-Sterling 12-inch armor-piercing shell weighing 350 pounds being used. It had a striking velocity of 1700 feet per second. It struck at an angle of about 3° to the right of the normal line, just below the middle of the plate. The shell broke, but the point remained welded in the plate. The plate was dished about 3 inches and cracked through from top to bottom. Many of the bolts used in fastening the plates together were started, but the structure as a whole did not seem to have sustained any permanent deformation.

In the third test a Johnson 12-inch compressed steel solid shot, fitted

with a soft steel cap and weighing 850 pounds, was fired with a velocity of 2000 feet per second. It struck in the left-hand upper corner of the plate, penetrated the latter and through the backing and a 2½-inch skin plate, a ½-inch maullet plate, and then broke. Some of the large pieces flew across the interior of the turret and cut through the skin plate and backing on the opposite side. The turret was moved handily to the rear about 16 inches. One result of this test was to show the good quality of this particular projectile.

The dog inside the turret gave no evidence of being any the worse for his novel experience.

In accordance with the orders of the Navy Department, Lieut. N. E. Mason, in charge of the Indian Head Proving Ground, made a careful examination of the experimental turret after its test. The first two shots had no appreciable effect on the turret. The Johnson shell, after getting through the plate, broke up, the largest piece entering through the covering plate on the rear side of the turret, piercing the backing and fracturing the rear cast-iron plate. The plate was forced in slightly on the target structure. The wooden backing in the rear of impact was carried away and badly squeezed and splintered. A portion of plating behind the backing was folded back and completely wrecked. The covering plates in the rear of the impact were twisted and ruptured badly, being split and bent back to a distance above the impact three feet to the left and two feet to the right. Portions of the channel beam forming the structure in the rear of the impact, three feet long, were ripped off and thrown to the rear, one portion landing on the opposite side of the turret and another being driven in the hole made by the head of the shell as it passed into the backing. The vertical covering plates directly in the rear and on the opposite side of the turret from impact contained eighteen holes and numerous deep gouges and other marks of flying fragments. The turret structure over an area of four square feet where the fragments struck was badly wrecked. A 15-inch cast-iron plate was badly cracked and wrecked, two large pieces of the plate being thrown to the rear. The report states that the turret structure as a whole shows no sign of deformation, either by measurement or examination. If a shell should by any possibility ever enter a turret on board of one of the battle-ships, the men inside would have small chance of escaping without loss of life or injury. It is very unlikely, however, that a shell would be able to strike a turret plate with 2000 feet per second, the velocity necessary to penetrate it, as the distance at which a battle would take place between two battle-ships would be about half a mile, while at the Proving Ground the plate was only 359 feet away from the gun when fired at. During the Chinese-Japanese war a turret was penetrated by a shell which caused terrible damage to the men and to the structure itself.

Test of Armor Plates and Projectiles.

An experimental shell burst in a 6-inch gun at the Indian Head Proving Ground on May 2, cracking the gun. Fortunately no other damage resulted. The gun was the one taken off the Dolphin and sent to the Proving Ground for experimental purposes some years ago. A shell carrying five pounds of gun-cotton and fitted with a Maxim fulminate detonator was placed in front of a charge of 45 pounds of brown powder. All the officers present retired to the bomb-proof and the charge was

exploded. Immediately afterwards was heard a rending sound. Fragments of the shell came from the mouth of the gun, and an examination of the weapon showed that it was cracked. In addition to firing this shell, there were also fired three 6-inch Johnson cast-steel shell, fitted with copper caps. The result of the experiment was very gratifying, and showed the excellence of the shell, as well as the value of copper for caps, it being the opinion of the experts that it gave as good results as soft steel. The first shell fired, with a velocity of 2100 feet per second, penetrated a 10-inch Harveyized plate. The bourrelet broke off and the remainder of the shell rebounded. Another shell of the same make and caliber, and also fitted with the copper cap, fired at a 7-inch plate at an angle of 20 degrees, broke up. The third shell was fired at the plate, impact normal, and succeeded in getting through and entering the butt.

At a trial of a 12-inch armor-piercing Carpenter shell at Sandy Hook on May 22, the shot, it is reported, penetrated 13½ inches of nickel-steel armor and six inches of oak backing, and was recovered from the sand uninjured. The shot demonstrated, it is believed, that the 16-inch gun need not be built at present. The projectile weighed 1100 pounds. The muzzle velocity and the distance are not given, but they were so regulated as to make the impact equal to a range of one mile.

A 12-inch and an 8-inch plate, which had formed parts of groups of armor manufactured by the Carnegie Company, and which had been rejected by the Ordnance Inspector on account of defects, were fired at at the Indian Head Proving Grounds on Wednesday, June 3. The primary object of the test was to ascertain what the shells could do against plates of the double-forged character. The most the 12-inch shell could do was to break off a corner of the plate, through the impact, and the 8-inch shells produced a back bulge. As a result of the trial, Capt. Sampson proposes to change the specifications for the ballistic test of shells for acceptance so as to give the manufacturers a greater chance of having their product pass the required trial. The 12-inch shell was a Wheeler-Sterling experimental projectile, and was manufactured under the contract entered into between the Government and the Wheeler-Sterling Company last November. It was given a velocity of 1800 feet per second and struck the plate in the upper right-hand corner, breaking off a section. It broke into fragments, but portions of the shell succeeded in getting through and fell behind the structure. Had this plate been supported by others, as on board ship, ordnance experts say that the shell would have done no damage, but would have smashed up on the face of the plate.

Two 8-inch shells were fired, one of the Wheeler-Sterling type and the other of the Carpenter variety. Both shells penetrated the plates several inches, producing a back bulge and breaking up, the bases falling in fragments in front of the structure. Capt. Sampson concluded, as a result of these tests, that it would be necessary to increase the velocity for firing 12-inch shells in acceptance tests from 1662 feet per second, for which the contract now calls, to 1850 feet per second, and for the 8-inch shell the velocity would have to be much higher in proportion. The experiments which are now in progress at the proving grounds are for the purpose of developing a temper in the shell which will perforate the double-forged armor. The results have so far been a complete victory for the armor, and speaks well for the character of plate on board our modern men-of-war.

In addition to the tests mentioned at the proving grounds, a sample of 6-inch smokeless powder was fired, which gave a velocity of 2600 feet per second. A bursting charge of smokeless powder was placed in a 6-inch shell and fired. The results showed that the smokeless powder had a greater bursting energy than the ordinary powder, but the advantage is not great enough to compensate for the extra expense in its manufacture to which the Government would be put in case it decided upon its adoption for this purpose.

An important test of armor-piercing projectiles occurred on Tuesday, June 16, at the Indian Head Proving Grounds. The shells fired included two 8-inch, one of the Carpenter and the other of the Wheeler-Sterling type, and two 12-inch, equally divided. The 12-inch shells were given velocities of 1900 feet per second each and fired against a 12-inch Carnegie Harveyized plate. Both shells perforated the plate and were recovered back of the butt in perfect condition. Each of these shells represented a lot of fifty projectiles, which were accepted upon the showing they made. In the case of the 8-inch projectiles, they were each fired with a velocity of 1800 feet per second against a plate of eight inches in thickness. Both shells penetrated the plate and broke up, fragments falling between the plate and the butt. These shells also represented lots of fifty each, and having met the requirements, the lots were accepted.

SHIPS OF WAR.

[THE UNITED STATES.]

THE MASSACHUSETTS.

[ARMY AND NAVY JOURNAL.]

The Massachusetts underwent her full-speed trial on April 25. The Board of Inspection and Survey has made a very flattering report on the battle-ship. It appears from the report that the time required for the Massachusetts to make the run of 31 knots over the Cape Ann course, in a northerly direction, was 1 hour 55 minutes and 58.97 seconds. On the return run over the course the time occupied was 1 hour 54 minutes and 24.47 seconds. The time occupied in making the total run of 62 knots was consequently 3 hours 50 minutes and 23.44 seconds. The total corrections applied to the trial course made the distance through the water 62.23571 knots, and the true mean speed of the battle-ship at 16.2079 knots per hour. "At the end of the return run," says the report, "the helm was put hard over both ways before the speed was materially reduced. The steering gear worked well, except as to the time of putting the helm over, which was, from hard a-port to hard a-starboard, 29 seconds." The board submitted these conclusions: That the vessel is sufficiently strong to carry her armor and armament, equipment, coal, stores and machinery; that the vessel, including hull, fittings, machinery, engines, boilers and appurtenances, etc., is strong and well built; that the machinery worked well, and its performance was in all respects satisfactory. The total weight of machinery is 896.39 tons, which is 21.39 tons in excess of the contract requirement. The board also states that the vessel is complete in all respects, with the exception of some work

which is of minor character, and which it points out in detail. "So far as the board had an opportunity of forming an opinion," the report continues, "the seaworthiness and general efficiency of the battle-ship Massachusetts are excellent. Her steering qualities in smooth water were tested, and leave nothing to be desired, except as to the time of putting the helm over." The Department has mailed to the Cramps a statement of the work yet to be finished, with instructions to push it as rapidly as possible, as the Department desires to place the battle-ship in commission as early as possible.

Included in the report of the Board of Inspection and Survey is a report made by Lieut.-Comdr. Seaton Shroeder. This report deals essentially with the ordnance features of the vessel. It states that the after turrets were turned while the ship was rolling six degrees on each side in the time noted, as follows: 13-inch turret, 38 seconds; starboard after 8-inch turret, 11 seconds; port after 8-inch, 18 seconds. The 13-inch turret turned noticeably faster when going with the roll and noticeably slower against the roll, but not to such an extent as to give any impression that the power would not be sufficient for a much heavier roll; there was no slipping of the friction clutch. The 8-inch turrets were apparently not affected in their motion by the roll. Lieut.-Comdr. Shroeder states that as at present stowed the stream anchors would possibly be torn from lashings when firing the after 13-inch guns with extreme train forward; there is also no means of handling them. From the after search-light control-stands the light beams cannot be seen striking the water when thrown more than four points forward of the beam. The neighboring 6-pdrs. and their crew will also seriously interfere with efficient service of these controllers. The best place for them would be on brackets outside the railing of the check-compass platforms aft, from whence a good all-around view could be obtained. The forward 8-inch turrets cut off the field view from the conning tower. If one peep-hole on each side were cut in the conning tower above the present ones, the horizon could be seen over those turrets through an arc of about 25 degrees farther aft on each side. At the speed between 12 and 13 knots, which causes the maximum vibration, the 13-inch guns of the Massachusetts did not vibrate in their mounts as did those of the Indiana. The signal topmast vibrates at times so badly as to endanger the truck-light. "The Massachusetts is a fine ship," the report concludes. "She rolls very little, except with the swell well aft, and under those circumstances her motion is naturally easy and regular. In shoal water, even when going slow, she squats some two feet. She turns readily with helm or screws, and can be safely handled in narrow waters. A helmsman not accustomed to a ship so broad and with such heavy ends is apt to have difficulty in steering a straight course; but in experienced hands she can be, and has been, steered very well in deep water."

THE BROOKLYN.

The Brooklyn left Delaware Breakwater and went to sea shortly after 9 o'clock Monday morning, May 11, for her builders' trial trip. She proceeded directly off shore about 75 miles to deep water. The run was made under forced draught, and consumed about three hours, during which time the cruiser developed a speed of 21.07 knots an hour. This speed was more than a knot greater than the contract with the Govern-

ment calls for, which requires that the Brooklyn shall average 20 knots an hour. The average revolutions of the screws were 132, and the steam pressure 155 pounds. The horse-power developed cannot be given, as the indicator cards have not yet been worked out. The performance of the engines was excellent. No stoppage for repairs was made. During the run not a bearing or journal became hot. The weather conditions for the trial were perfect. There was only a slight breeze from the southwest, and the sea was perfectly smooth.

The wonderful steadiness of the ship while being driven under forced draught was remarked by all on board. The fine lines of the hull were shown in the way the Brooklyn goes through the water when being speeded. There was no great bow wave, but the vessel threw the water to each side as cleanly as a knife cuts through cloth. A run was also made between the two lightships on Five Fathon Bank Shoal. On the first run, with the screws making 100 revolutions, 16.70 knots were made. At 115 revolutions 18.41 knots were logged, and at 124 revolutions, 19.75 knots were reeled off. The object of the trial between the lightships was to obtain data from which the builders can form some judgment as to the number of revolutions required to obtain the guaranteed speed of the ship.

As compared with the New York, the Brooklyn is of 670 tons greater displacement, measuring 9150 tons against the New York's 8480 tons. She is 400 ft. long, has 64 ft. 8 in. beam, and 24 ft. mean draught. She is armed with eight 8-inch guns—two more than carried by the New York—ten 5-inch guns, and sixteen 6-pounder rapid-fire and machine guns. She is protected by a complete steel deck, 3 inches thick on the flat and 6 inches on the slope, and by a water-line belt of 3-inch steel plate backed by a double thickness of hull plating over the whole length of the "vitals." Moreover, the 8-inch guns are protected by 10 inches and the 5-inch guns by 4 inches of steel.

The Oregon.

The report of the Board of Inspection and Survey on the trial of the Oregon states that the vessel, having been weighted to a mean draft of 24 feet, made her speed trial on May 14 in Santa Barbara Channel. The speed of the Oregon as observed by transits was 16.78 plus knots or nautical miles, made up of two runs over the course, the first from eastward to westward at the rate of 17.78 knots; the second from westward to eastward at the rate of 16.49 knots, giving an average of 16.78 knots. This speed having been corrected by the application thereto of the resultant tidal and current observations became 16.791 nautical miles, which is the speed of the Oregon. At 8.10, May 14, the engines having been given a preliminary warming-up, the Oregon crossed the eastern range of the course under full steam, and as obtained by careful observation, went at the rate of about 17.3 knots. As she ran to the westward a swell was encountered, and before reaching Point Conception the head wind was very fresh and the swell became a moderate sea, the water breaking over her bows as she pitched. Running a mile or more to the westward after leaving the course, the sea became quite heavy. The turn to the eastward was made with 7 to 10 degrees of the helm. She turned in a very small circle; the heavy sea, which when ahead had caused her to pitch from 1½ to 2 degrees, when it came abeam caused her to roll

very slightly—not over 2 degrees. A turn made in a more moderate sea has an estimated diameter of not over ten ships' lengths.

The report finds that the Oregon is sufficiently strong to carry her armor and armament, equipment, coal stores and machinery, and that the vessel is strong and well built. She is in all respects complete and ready for sea with a few minor exceptions which the board points out. One of these is mentioned as unsatisfactory berth protective deck plates, which, by telegram of the Secretary of the Navy, the board is authorized to consider as unfinished work.

"The board would state," the report says, "that in addition to the ordinary means by which during the short duration of the trial trip opportunity is given to form valuable opinion on all points including seaworthiness, we were furnished during our return from Santa Barbara to San Francisco with a fresh gale from the northwest which produced a heavy sea on the port bow. We were thus given an opportunity to watch the performance of the Oregon in a heavy sea. It is unanimous," the report says, "in pronouncing her an excellent sea boat—stable, easily steered, powerful, with remarkable freedom from vibration. Steaming 17 knots against a moderate head sea, or 7 or 8 against a heavy sea, her pitching was easy and there was no squatting, and the motion was that of a rocking-chair. There was no time during the trial that all of her guns could not have been efficiently served. We consider her a most excellent gun platform. The ship is remarkably free from vibration of hull—such as was observed is local. Going ahead full speed, 15 knots, the engines were reversed and the ship came to a dead stop in three minutes.

"In conclusion," the board says, "the board desire to express its opinion that the Oregon is in every respect a most efficient and formidable battle-ship, speedy and substantial, and that the United States is to be congratulated upon the addition of this vessel to its naval resources."

There is a strong probability that there may be a change in a part of the armament of the battle-ships Kearsarge and Kentucky. This relates to the 5-inch guns. The Ordnance Bureau is desirous of substituting 6-inch guns for the smaller type, and in any event, if the opinion of Capt. William T. Sampson, chief of the bureau, prevails, the battle-ships to be authorized at this session will have 6-inch guns as a portion of their main battery. The Kearsarge and her sister ship are to be armed each with four 13-inch, four 8-inch and fourteen 5-inch guns, besides those composing their secondary batteries. Capt. Sampson would like to have about ten 6-inch guns as a part of their armament. While before the Walker board, which is considering the question of armament for the proposed ships, Capt. Sampson made known his preference of 6-inch guns over 5-inch, and the board will consider the suggestion in connection with the other recommendations which it has before it.

Advocates of inclined turrets intend to make a strong fight for the adoption of their choice as features of the battle-ships to be authorized at this session of Congress. Chief Naval Constructor Hichborn has altered the model of the experimental turret recently fired at at the Indian Head Proving Ground from a vertical into an inclined type. With this design he proposes to demonstrate to the authorities the many advantages possessed by this type of turret over that now in service. This question will be raised in connection with the recommendations by the Walker board in its report on the armament for the new ships.

Under its recommendations the four 13-inch guns are to be mounted in pairs in two single turrets, one located forward and the other aft. It is these turrets which will be a matter of considerable discussion between the several bureaus of the Navy Department during the next few months, and in it the old question of the comparative value of vertical and inclined turrets will be revived.

Secretary Herbert gave out, in regard to the Walker report on the armament for the proposed battle-ships, a statement that "As a result of its investigations the board recommends a slightly different ship, with a somewhat different arrangement of battery, from any heretofore built. While speaking very favorably of the superimposed turret, as designed for the Kearsarge and the Kentucky, the board does not recommend installing more turrets of this description until experiments with the two ships named have demonstrated their utility. The hull of the ship recommended is that of the Kearsarge and Kentucky, but so modified as to be similar in many respects to the Iowa. The main battery recommended is composed of four 13-inch and fourteen 6-inch guns so arranged as to fire two 13-inch and four 6-inch guns directly ahead, two 13-inch and two 6-inch directly astern, and four 13-inch and seven 6-inch in broadside. The board also recommends that the normal draft upon which the ship's speed is based should be the fighting draft or the draft of the ship with at least two-thirds of her movable weights on board. It also recommends various minor changes in quarters and internal arrangements of the ship in the interest of the health and comfort of the enlisted men. It is believed by the Department that the ship outlined as above will be an improvement upon any yet built in this country. The Secretary of the Navy, after consulting with the chiefs of the Bureaus of Ordnance, Construction and Repair, and Steam Engineering, has approved the general features of the report of the board, and directed that the plans be taken up without delay. The contracts for all the vessels authorized in the new law, battle-ships and torpedo-boats included, will be made within the time prescribed in that act. The Secretary has already decided upon all the preliminary steps.

BATTLE-SHIPS NOS. 7, 8 AND 9.

The Secretary of the Navy has issued a circular calling for bids to construct battle-ships Nos. 7, 8 and 9. The limit of cost of each vessel, exclusive of armament, is $3,750,000. The ships are to be built in conformity with the provisions of the act of August 3, 1886, as to materials, engines, boilers, machinery, etc. No premiums are authorized in the appropriation bill providing for their construction. Under the act the contracts for the construction of the three vessels are to be made on or before October 8 of this year. The Department will invite proposals, either under its own plans and specifications or under plans and specifications submitted by the bidder and approved by the Secretary of the Navy. The circular gives the general features of the vessels. The length on the load water-line, normal displacement, is to be 368 feet; the molded breadth at load water-line, 72 feet; the mean draft at normal displacement, 23 feet 6 inches; normal displacement, about 11,500 tons; total coal capacity, loose stowage, 1200 tons. The battery will consist of four 13-inch guns, fourteen 6-inch rapid-fire guns, sixteen 6-pounders, four

1-pounders, four machine guns and one field gun. The complement of officers and men will be 490. The speed to be maintained at sea for four consecutive hours is to be not less than 16 knots an hour. The hull is to be of steel, not sheathed, with a double bottom and close water-tight subdivisions. There will be two military masts, with fighting tops. No sail will be carried. The protection of the hull against injury to the water-line region is to be afforded by means of a side-armor belt of a maximum thickness of not less than 16½ inches, and a mean depth of 7 feet 6 inches. The belt is to extend at least from the stern to the after barbette, and to maintain the maximum thickness throughout the engine and boiler spaces. From thence forward it may be tapered gradually to a uniform thickness of 4 inches.

The transverse armor at the after end of the belt and just forward of the boiler will be not less than 12 inches in thickness. The barbettes for 13-inch guns will have armor 15 inches thick, except in the rear, where it will be reduced to 10 inches. The turret armor is to be 17 inches thick in front and 15 inches elsewhere. From barbette to barbette the sides of the vessels from the armor belt to the main deck will be protected by plates not less than 5½ inches thick. Coal is to be carried back of a portion of this casemate armor. There will be a protective deck to extend throughout the length of the ships. Where worked flat the deck will be not less than 2¾ inches, and where its sides are inclined the slopes will be 3 inches thick forward and 5 inches thick aft. A cellulose belt is to be fitted along the sides of the whole length of the vessels. A conning tower is to be fitted, 10 inches in thickness, having an armored communication tube not less than 7 inches thick, affording protection to the voice-tubes, bell-wires, etc. A second armored station will be located aft. It will be constructed of plates 6 inches thick. In the wake of the 6-inch guns on the main deck there is to be continuous armor 5½ inches thick extending between the turrets. Further protection is to be afforded by 1½-inch splinter bulkheads between the guns extending from deck to deck. The 6-inch guns on the upper deck will also be protected by 5½ inches of armor and 1½-inch splinter bulkheads between guns. Protection will be afforded the smaller guns by sheaths and extra side plating. The vessels will be driven by twin screws. The engines are to be of the vertical triple-expansion type, two in number, in two separate compartments. The boilers are to be of the cylindrical single-ended pattern, eight in number, placed in four compartments. The electric lighting plant is to consist of three units, each unit having engine, dynamo and combination bed-plate, and each dynamo having a rated output of 400 amperes at 80 volts.

The Department will have a number of torpedo-boats at its disposal this fall. The official statement gives the date of completion of five of these vessels in November next. Another will be completed by next February. The submarine torpedo-boat is being rapidly advanced toward completion, and is slated to be ready for her official trial by January of 1897.

The Holland Submarine Torpedo Boat.

[Scientific American.]

Mr. J. P. Holland, an adopted citizen of the United States and a native of Ireland, for nearly twenty years has been working on this subject—

submarine navigation—and has built three boats, the first of which was begun in 1877. Ten years later he proved his plan to be so far practical as to be able to interest the naval department, which issued a circular to inventors calling for designs. Meanwhile in foreign countries other submarine boats were being tried, none of them seeming to prove entirely successful, or at least not succeeding in winning the desired confidence of the naval authorities. But at last, in the present boat, we have a *bona fide* war vessel being built under contract for the United States Government, and one which it is hard to believe will not be a valuable auxiliary to the Navy.

The Holland vessel is of cigar shape, with frames 3½x3½ inches, weighing 12 pounds to the foot. Her outside plating is ½ inch thick, tapering to ⅜ inch at the extreme ends of the vessel; for a portion of her length she is double skinned. She is propelled by triple-expansion engines actuating triple screws as long as the smoke-stack is above the surface; and for her diving operations, when the smoke-stack has to be completely housed, the residual pressure of the steam will be used for her propulsion, water heated under pressure evolving steam for a long time. Then, when this fails, she will have her storage batteries and electric motors to operate the propellers.

Three stages of flotation are provided for; in her light condition with the hull well above the water she is to make 13½ knots per hour; her next stage is that termed the "awash" condition. For this the body of hull is submerged, an armored superstructure, including a conning tower with 8-inch Harveyized steel plates, projecting above the surface, while concentrically placed, the air-tube and the smoke-stack rise above the whole. The superstructure is carried forward and aft, and pointed at both ends to give a clean entrance and run, so as to interfere as little as possible with the speed. Her speed under these conditions is to be 12½ knots an hour. Her third stage is the submerged condition. For this the smoke-stack and air-tube are housed, the opening through which they projected is hermetically closed, and the vessel is in condition to be sunk to a depth not exceeding 45 feet, her strength of construction being sufficient to enable her to resist the pressure of the water at this depth. She still has flotation, there being a margin of 375 pounds of buoyancy in her favor, the submersion being obtained by special devices. Submerged she is to make 6½ knots per hour.

The submersion is to be effected in two ways. At her stern she carries horizontal rudders. If the vessel is moving, by inclining these rudders the bow is caused to pitch downward and the vessel runs down an inclined plane determined by her axis, the inclined plane really representing the resultant of her buoyancy as a vertical upward component and her inclination of axis as a downward acting component. This diving action is similar to that used in the old Tuck submarine boat Peacemaker, which has been several times described in our columns. But the vessel is also to be able to dive from a state of rest. To secure this power she carries at her bow and stern two screws with vertical axes actuated by electric motors. By working these screws in one or the other direction, at varying rapidity, the vessel can be sunk rapidly, can be maintained at any desired level, can be rapidly drawn upward to the surface, or its approach to the surface can be made as slow as desired.

It having at last been settled that ocular navigation is impracticable under water, a tube is provided to be raised above the surface when the

vessel is submerged, which tube is to carry an inclined mirror or prism, camera lucida fashion, by which the commander will be able to watch the enemy and guide his course. In the restricted volume of the boat a compass cannot be used, owing to the proximity of so much iron and steel. An attempt is to be made to hold her mechanically in a straight course by a triangular drag. The theory of this is that she should be started on a proper course by ocular methods, with the drag set astern of her when on such course, any inclination from the desired direction causing the drag to pull to one side or the other, actuating the rudder so as to bring her back to her original course.

She is to carry five automobile torpedoes, two expulsion tubes and the necessary air plant for operating them. When diving, she must be able to reach a depth of 20 feet below the surface of the water within one minute from the light condition; when awash, she must be able to dive to the same depth within 30 seconds. She has an automatic pressure diaphragm which governs her submersion so that she cannot exceed the safe depth.

The air supply is primarily obtained from reservoirs, where it is stored under 2000 lbs. pressure. Moreover, a float with air-tube is provided which can be allowed to ascend to the surface, when air can be pumped down through the tube into the hull.

The following are the dimensions: Length, 80 feet; diameter, 11 feet; displacement, light, 118.5 tons; displacement, awash, 137.84 tons; displacement, submerged, 138.5 tons; reserve buoyancy submerged by motion or awash, 0.66 tons; reserve buoyancy submerged lying still, 375 pounds: horse-power of engines, 1800.

Provision is to be made for the escape of the crew in case of accident. This will take the shape of buoyant diving helmets or suits, and a method of opening the hatch so as to escape if the boat remains submerged.

[ENGLAND.]

THE MARS.

[ENGINEERING.]

The battle-ship Mars, which was floated out of Messrs. Laird's dock on Tuesday, March 31, belongs to the same class as the Majestic and Magnificent, which have been fully described already in Engineering, but the leading dimensions may be repeated: Length, 390 ft.; breadth, 75 ft.; mean draught, 27 ft. 6 in.; displacement, 14,900 tons; freeboard forward, 25 ft., aft, 18 ft. 6 in.; power of engines with forced draught, 12,000 indicated horse-power, with natural draught, 10,000; speed, natural draught, 16½ knots, forced draught, 17½ knots; coal carried at the designed load draught, 900 tons, with a reserve of 500 tons a side, making a total stowage for 1900 tons, with which she will steam at 10 knots for about a month, or 8000 knots. The reserve bunkers form additional protection with an armored deck behind side armor. The barbette guns are above the waterline 27 ft. The citadel or side armor is 220 ft., with a vertical height of 15 ft., and is of Harveyed steel, 9 in. thick. The barbettes have armor 14 in. thick. The protective deck, from lower edge of armor, covering machinery, magazines, and other vital parts, has 4 in. on slopes to 2½ in. on the flat, and extends to the extreme ends. The port and starboard engines and boilers are separated by a middle-line bulkhead. The main

propelling machinery consists of two sets of engines of the triple-expansion inverted type of Messrs. Laird Brothers' design. The screw propellers are four-bladed, the blades and bosses being of manganese bronze. The boilers are eight in number, single-ended, of the cylindrical return-tube type. Each pair of boilers is in a separate water-tight compartment, with independent coal supply, separate access to and from main deck, etc. There are two distillers with circulating and distributing pumps, four Admiralty type main feed and four auxiliary feed pumps, of ample size to supply the whole of the boilers at full power, and four double cylinder double-acting bilge and fire pumps, and a pump for pumping out the drain tank. The several pumps are connected to the large drain pipe and double bottom. General ventilation is secured by two large fans 72 in. in diameter, and eight fans 72 in. in diameter supply the forced draught for the boilers. The Mars illustrates the advantage of building these large battle-ships in dock in preference to building them on a slip and launching them, as she carries with her all her citadel armor, most of the barbette armor, and four casemate fronts; indeed, all the armor-plating would have been completed had it not been for the press of work in Sheffield rendering it impossible for the armor-plate manufacturers to make delivery as early as required. The main boilers are on board, with all mountings and connections complete, ready for steam, save the funnels. The whole of the auxiliary machinery is also in place, and pipes and connections fitted, and the main engines are fully two-thirds erected on board, so that the vessel, as floated out from the building dock, is in a far more advanced state than would have been the case had she been launched in the ordinary way. The order for the Mars was given exactly two years ago on March 26, and the steel and other materials were obtained and her keel laid on June 2, 1894, practically 22 months to date. When ready for the pennant in six or eight months, she will have a complement of 750 men.

THE RANGER.

The Ranger is the third and last of three torpedo-boat destroyers which Messrs. R. and W. Hawthorn, Leslie and Co., of Newcastle-on-Tyne, have built for the Admiralty. On April 1 she made her official full-speed trial off the mouth of the Thames, the particulars of which are of interest. The vessel, like her sisters the Sunfish and the Opossum, is 200 ft. long and 19 ft. wide. The draught on trial was 5 ft. forward and 8 ft. 1½ in. aft, at which the displacement was 278 tons. These figures refer to the commencement of the trial. Naturally as coal was burnt the displacement and draught decreased. The trial was for the usual three hours, six runs being made on the Maplin measured mile, the mean speed for the whole distance being 27.172 knots. The Ranger has three-stage compound engines, having cylinders 18½ in., 28 in., and 42 in. in diameter, the stroke being 18 in. The cooling surface in the condensers is 3000 square feet. The boilers are of the Yarrow type, and are eight in number. Each has a grate area of 21 square feet, and a heating surface of 1063 square feet. On the trial the average steam pressure in the boilers was 194 lbs. to the square inch, the air pressure in the stokeholds 3.07 in., and the vacuum 24.2 in. The revolutions averaged 348.25 per minute. The aggregate horse-power for both sets of engines was 4055 indicated. During the six runs on the mile the speed was 27.093 knots, which, it will be seen, was less than that for the whole distance. This is a cir-

cumstance that has before occurred on the trials of destroyers having water-tube boilers, but which we do not remember ever to have observed in the case of flame-tube boilers. It may doubtless be taken as a testimony to the superior endurance of the former class of steam generator, or perhaps one should say to the greater ease with which the best designs of water-tube boilers are fired, and, therefore, to the superior endurance of the stokers. As is well known, the "human factor" is almost as of great importance as the "machine factor" in the trials of these small quick-running craft.

The Haughty.

The torpedo-boat destroyer Haughty, which was built by Messrs. William Doxford & Sons, Limited, of Sunderland, and fitted with eight of Yarrow's water-tube boilers, on her official trials made 27.949 knots as the mean on the six measured-mile runs, the engine revolutions being 371.74. The speed registered on the three hours' trial was 27.525 knots. The revolutions were 362.3, with an indicated horse-power of 4224, steam pressure in the boilers 188 lbs.

Mr. Beauchamp Towers' ingenious apparatus for providing a steady platform at sea has been fitted by Sir W. G. Armstrong & Co. to the torpedo-boat destroyers Swordfish and Spitfire, and is also to be supplied to a Chilian cruiser now building at Elswick. The apparatus, it will be remembered, depends on the fact that a gyroscope tends to maintain an invariable plane of rotation. In practice, a gyroscope is arranged to rotate about a vertical axis. As the vessel rolls, the gyroscope, maintaining its original plane of rotation, tilts relatively to the vessel, and this relative motion is used to control the supply of water to a set of four hydraulic cylinders connected to the steady platform in a suitable manner. In practice it is found that with it a search-light on a small vessel can be kept quite steady on a mark even in a heavy sea.

The Renown.

The first-class battle-ship Renown, which has been built at Pembroke, made her full-speed contractors' steam trial in the Channel on April 6. The eight hours' natural draught trial was run on the 27th of March.

The Renown is a particularly interesting ship at the present time, as she is to be the prototype of the five new battle-ships which are in this year's naval programme. The vessel is 380 ft. long and 72 ft. wide, and is designed to have a displacement at load draught of 12,350 tons. The engines are of the three-stage compound type, having cylinders 40 in., 59 in., and 88 in. in diameter by 4 ft. 3 in. stroke. The high-pressure engine has a piston valve, the ordinary flat valve being used for the intermediate and low-pressure engines. The propellers are of gun-metal, and are 16 ft. 6 in. in diameter and 21 ft. mean pitch. There are eight single-ended return-tube boilers, each 16 ft. 6 in. in diameter and 10 ft. 3 in. long. They have each four furnaces. The total grate area is 793 square feet, and the total heating surface 24,840 square feet.

For the eight hours' natural-draught trial a very early start had naturally to be made. The conditions were fairly favorable to the ship, the wind being of a strength from 3 to 4 and the sea moderate. The trial ground selected was from the Start to the Lizard, the ship running up and down

the coast far enough out to be in deep water. The mean results were: Steam, 143 lbs.; vacuum, starboard 26.9 in., port 26.9 in.; revolutions, starboard 97.5, port 98.2; indicated horse-power, starboard 5233, port 5475—total, 10,708; speed, 17.9 knots. Messrs. Maudslay, Sons & Field, the makers of the machinery, were responsible for an indicated horse-power of 10,000 only on the natural-draught trial, but more than once during steaming the engines easily attained 11,000 indicated horse-power, while the mean was 708 in excess of the stipulated power. The mean speed was exactly 1 knot more than her designers anticipated that the vessel could attain on her natural-draught trial, and $\frac{2}{10}$ knot more than it was estimated she would steam under forced draught with 12,000 indicated horse-power.

We now turn to the full-power trial of April 6. The ship had been taken into the Hamoaze after her natural draught trial, and in steaming out of the very crooked channel leading into Plymouth Sound gave unmistakable evidence of her handiness, both engines being kept going steadily ahead, the vessel swinging to her helm with remarkable promptitude. Such a performance was highly gratifying to those who remember the somewhat erratic performance of certain armor-clad ships of past times. The ship having passed out of the Sound into the Channel, hatches were soon closed and the trial commenced at 12.12 P. M., the course being first to the westward. The day was all that could have been desired for a trial, the wind being no more than a gentle breeze and the sea quite smooth. The engines were opened out full, there being no difficulty in keeping steam, in fact, the safety valves were lifting part of the time.

As will be seen, the air pressure was quite moderate, averaging about $\frac{7}{10}$ in., and though the engines developed 901 units above the contract horse-power, the engineers are confident that considerably more power could be obtained were the slides altered and the full air pressure allowed by the Admiralty regulations taken advantage of. How far this would result in additional speed is, of course, an open question, but the ship seemed to pass through the water so easily at the highest rate of steaming that possibly a good deal more might be got out of her if considered desirable.

The following are the mean results of the half-hourly observations on the full-speed trial: Steam pressure in engine-rooms, 145 lbs.; vacuum, 27.3 in.; air pressure in starboard boiler-rooms, .6 in.; in port boiler-rooms, .8 in. Revolutions of starboard engines, 101.6 per minute; of port engines, 106.5 per minute. Mean pressures per square inch of piston: Starboard engines: High-pressure cylinder, 67 lbs.; intermediate cylinder, 27.8 lbs.; low-pressure cylinder, 13.5 lbs. Port engines: High-pressure, 63.6 lbs.; intermediate cylinder, 28.7 lbs.; low-pressure cylinder, 13.4 lbs. Indicated horse-power, starboard engines, high-pressure, 2206; intermediate cylinder, 1993; low-pressure, 2141—total, starboard, 6340. Port engines—total, port, 6561. Total indicated horse-power, 12,901, or 901 in excess of the contract. The engines worked well and steadily throughout the trial. The speed, as taken by cross bearings from points on the coast, was 18.75 knots for the whole distance steamed, the vessel making several turns and running up and down so as to equalize the influence of the tide.

A subsequent thirty hours' consumption trial shows that her most economical rate of steaming is three-fifths of her full natural draught engine power, at which she made a speed of over 15 knots, the vessel being ballasted to give her the same draught, 26 ft. 9 in., as she will have

when in commission fully completed for sea service. The mean results of the trial were: Steam, 137 lbs.; vacuum, starboard, 27.8 in.; port, 26.8 in.; revolutions, starboard, 85; port, 88.6; indicated horse-power, starboard, 3143; port, 3044; total, 6187; air pressure, nil; speed, 15.3 knots. The coal consumption was 1.88 lb. of coal for each indicated horse-power per hour; the coal stowage capacity at load draught is 800 tons.

The Desperate.

The official trial of the torpedo-boat destroyer Desperate was successfully made on April 16. Hitherto contractors have been allowed unlimited coal and horse-power, no restrictions being placed upon them, so long as they attained the required speed with the specified weight on board. In the case of the 30-knot vessels, not only was an additional speed of 3 knots over that of the former number demanded, but it was also laid down that the coal consumption on the full-power trial should not exceed 2½ lbs. per indicated horse-power per hour, if the minimum load of 35 tons were carried, the load penalty being 2 tons additional for every tenth of a pound that the coal consumption exceeded the 2½ lbs. It is well known that the very high speed of these little vessels has hitherto been largely due to a total neglect of the economy question when running at the highest speeds, although the boats were fairly economical at lower powers. The practice was perfectly defensible, because the boat would not be expected to run at her highest speed, either in war or peace times, but for short periods, and then a few pounds of coal would not be of great importance unless the circumstances were altogether exceptional. Experience shows, however, that the conditions were not impossible. The trial was run on the Maplin mile in rough weather. A weighed quantity of coal, estimated to be sufficient to take the boat down river to the trial ground, was placed in bags, whilst in the bunkers there was a quantity of coal estimated to be sufficient for the three hours' trial. On the vessel reaching the mile, and the trial commencing, there remained over a ton of coal still in the bags, and this was of course put by, so as to be beyond the reach of the stokers. At the termination of the three hours a considerable quantity of coal remained. The bunkers were sealed up by the Admiralty officials, and immediately on the return of the boat the quantity was ascertained. The result of the trial was that the indicated horse-power was 5620, and the coal consumption 2.491 lbs. per indicated horse-power per hour. The speed on the whole run was 30.112 knots. The full load of 35 tons was of course carried. The steam pressure averaged 209 lbs., the vacuum 24 in., and the revolutions 398 per minute. The air pressure for draught averaged 3½ in. on the water gauge, and the coal burnt was about 80 lbs. per square foot of grate per hour. As our readers are aware, the Desperate has made previous trials, and on one occasion, with a reduced load, she made on the mile a speed of just over 31 knots, whilst on another occasion she steamed 30.46 knots with full load. On both these trials, which were of a preliminary nature, the coal consumption was above the standard. Messrs. Thornycroft have since fitted an arrangement by means of which air at 10 lbs. to the square inch pressure is introduced at the front about 2 ft. above the fire, there being 9 or 10 jets to each furnace. This was found on the trial to give very good results, the quantity of smoke being much reduced, and the flame, which so often results from the escape of unburnt gases, being entirely absent

from the chimney tops. The latter feature in itself is one of great importance in torpedo vessels. It will be seen from what has been said that Messrs. Thornycroft have scored still another success with their most recent boat. Certainly to drive a boat 210 ft. long at a speed of 30 knots on so light a consumption as that stated is a remarkable thing, even in these days of phenomenal speeds. The low fuel consumption bears out the consumption trials made by Professor Kennedy some time ago, when the water evaporated by the Thornycroft boiler was measured. The Admiralty have this week placed with this firm a further order for three more 30-knot destroyers and one of 32 knots. The latter will be a larger vessel than the Desperate class, and will of course have more power; there will be four boilers in place of three. The other three boats will doubtless be sister ships of the Desperate now that that vessel has done so well on trial.

THE HANNIBAL.

The battle-ship Hannibal was launched from the Pembroke dockyard on April 28. She belongs to the same class as the Majestic and Magnificent. Her keel was laid on May 1, 1894. The machinery, of 12,000 indicated horse-power, to give a speed of 17½ knots, is being supplied by Messrs. Harland & Wolff, Belfast.

THE HUNTER.

The torpedo-boat destroyer Hunter, built by the Fairfield Shipbuilding Company, had a three hours' trial of her machinery at Portsmouth on May 17. Her draught was 5 ft. 1 in. forward and 7 ft. 5 in. aft. The steam in boilers was 195 lbs., with a total indicated horse-power of 4245. She gave a mean speed of 27.245 knots during six runs on the measured mile. The trial was regarded as highly satisfactory.

THE ARROGANT.

The Arrogant, fleet cruiser, was launched from Devonport Dockyard on May 26. She is the first of four of the same type now under construction from the designs of Sir W. H. White, Director of Naval Construction, the others being the Gladiator, building at Portsmouth; the Vindictive, at Chatham; and the Furious, at Devonport. In size they are a medium between the second-class cruisers of the Astræa class and those of the Talbot type, and in several respects they differ from any cruisers yet built. The principal dimensions of the Arrogant are: Length, 320 ft.; breadth, 57 ft. 6 in.; mean load draught, 21 ft.; displacement, 5800 tons. Rapid progress has been made with the construction of the Arrogant. Her keel was laid on June 10, 1895, and she was pushed forward so expeditiously that she might have been launched two months ago had her underwater fittings been ready. The engines are of the twin-screw, triple-compound, vertical inverted cylinder type, and are guaranteed to develop 10,000 indicated horse-power. They are placed abreast of each other, in separate engine-rooms, divided by a fore-and-aft water-tight bulkhead. The high-pressure cylinder has a diameter of 26 in., the intermediate of 42 in., and the low of 68 in., while the stroke is 39 in. Other dimensions of interest are: Connecting-rod centers, 6 ft. 6 in.; piston-rod diameter, 7¼ in.; crankshaft diameter, 13¾ in. external and 7¾ in. in-

ternal; air pump, $27\frac{1}{2}$ in. in diameter and 11 in. stroke. Condensers of the cylindrical type, with a cooling surface of 5280 ft. in each, are placed in the wings of the engine-rooms. In all there are over 50 auxiliary engines, besides Normandy's distillers and Weir's evaporators. There are 18 water-tube boilers of the Belleville type. They are arranged in groups of six in three independent boiler-rooms, divided by athwartship water-tight bulkheads. The boilers have a grate area of 860 square feet, and a heating surface of 22,050 square feet. The steam pressure of the boilers is 300 lbs. per square inch, and by means of reducing valves placed in the main steam pipes it is reduced to 250 lbs. per square inch at the engines. The engines and boilers are being manufactured by Messrs. Earle's Shipbuilding and Engineering Company, Hull. The armament will be throughout of the quick-firing principle, and will consist of four 6-in., six 4.7-in., eight 12-pounder (12 cwt.), one 12-pounder (8 cwt.), and three 3-pounder guns. There will also be five Maxim machine guns and two 18-in. submerged torpedo-tubes. From a fighting top on the vessel's mast a 3-pounder Hotchkiss quick-firing gun will be worked. The Arrogant is to be completed for sea by March, 1897. It is expected that on an eight hours' full-power trial she will attain a mean speed of 18.5 knots. She will be fitted with bunkers capable of stowing 500 tons of coal.

THE SHARPSHOOTER.

During the last few months the Sharpshooter, gunboat, has been the means of affording instruction in the use of Belleville water-tube boilers to five distinct classes from the Portsmouth Reserve. Each class consists of 25 stokers, two leading stokers, two chief stokers, and two engine-room artificers. It was at first intended that the ratings sent to the Sharpshooter for instruction should be held in reserve for eventual appropriation to the cruisers Powerful and Terrible, both of which are being furnished with Belleville boilers. In consequence, however, of the frequent demands recently made on the drafting dépôt at Portsmouth, several of the men who had the special course of instruction in the Sharpshooter have been sent on foreign service, and, in fact, to vessels fitted with the ordinary cylindrical boilers. Up to the present the total number of stokers passed through the Sharpshooter is 125, of whom considerably less than 100 are now in the Portsmouth Reserve. The cruisers Powerful and Terrible are each to have a complement including 200 stokers, so that the Sharpshooter is likely to be employed on her present instructional service for many months if the Admiralty's original intention to supply experienced stokers only to the new cruisers is adhered to. Each class sent to the Sharpshooter is temporarily appointed to her for one month.

AUXILIARY CRUISERS.

[MARINE RUNDSCHAU.]

The English Government expends over fifty thousand pounds sterling in subsidies for the following steamers: Campania and Lucania, of Cunard Line; Teutonic and Majestic, of White Star Line; Himalaya, Australia, Victoria, Arcadia, of P. and O. Company; Empress of India, Empress of China, and Empress of Japan, of Canadian Pacific Line. Besides the foregoing vessels, the steamship companies place the following ships at

the disposal of the Admiralty without subsidies: White Star steamers Britannic, Germanic, Adriatic; Cunarders Etruria, Umbria, Aurania, Servia; P. and O., Britannia, Oceana, Peninsular, Oriental, Valetta, Massilia, Roma, Carthago, Ballaarat, Parramatta.

[FRANCE.]

THE BOUVET.

[JOURNAL OF THE ROYAL UNITED SERVICE INSTITUTION.]

On the 27th of April, at Lorient, the new first-class battle-ship Bouvet was successfully launched. She is the largest battle-ship as yet constructed or building for the French navy, and her dimensions are as follows: Length, 401 feet 2 inches; beam, 70 feet 3 inches; and with a maximum draught of 27 feet 6 inches she has a displacement of 12,205 tons. The engines are to develop 14,000 I. H. P., giving a speed under forced draught of 17.5 knots; there are three sets of engines driving three screws, and the boilers will be of the Belleville water-tube type. Protection is afforded by a water-line belt 16 inches thick amidships, and tapering to 8 inches at the bow and stern; there are two armored decks, the upper one being 3.8 inches thick; the barbettes for the heavy guns will be protected by 14.5-inch armor, and the turrets for the 6-inch Q. F. guns by 4 inches; all the armor will be of special steel, treated with nickel and manganese. The heavy armament will consist of two 30-cm. (12-inch) guns in closed turrets, one forward and one aft; of two 27-cm. (10-inch) guns also in turrets, one on each beam; these guns are of the latest (1893) model, and the breech mechanism can be worked by hand. The ammunition hoists discharge alongside the gun, and the projectiles are conveyed by means of an overhead rail, either directly to the loading position or to the rack made to contain eleven projectiles. The loading is done by hand, while the turrets are trained by hydraulic power, which is also used for the elevation of the guns. The secondary battery consists of eight 14-cm. (5.5-inch) Q. F. guns (model 1891) and eight 10-cm. (3.9-inch) Q. F. guns, also of the 1891 model. The eight 14-cm. guns are in armored turrets in couples, four firing right ahead and four astern, these turrets being in close juxtaposition to those of the heavy guns. The elevation is by hand, while the turrets can be worked either by hand or hydraulic power, as also can the ammunition hoists. The eight 10-cm. guns are on the superstructure on central pivot mountings, with 2-inch shields for protective purposes. There are, further, twelve 3-pounder Q. F. guns and twenty 1-pounder Q. F. guns distributed on the bridges and in the tops, with four torpedo-dischargers, two of which are under water.

THE GALILÉE.

The Galilée, French third-class cruiser of the Linois type, was launched at Rochefort on the 28th of April. With her sister, the Lavoisier, she has been designed by M. Albaret, and her total cost will be £208,000. The following are her dimensions: Length, 330 ft.; beam, 34 ft. 6 in.; stern draught, 17 ft. 10 in.; displacement, 6400 metric tons. She is to carry four quick-firers of 5.5 in. (model 1887) in sponsons two on a side, two of 3.9 in. model (1891), severally fore and aft, eight of 1.8 in., and eight of 1.4 in. There are two above-water torpedo-tubes. The six heavier guns

will have 2-in. steel shields, and the ship has a protective deck 1.5 in. thick. The engines are of the vertical triple-expansion type, supplied by Belleville boilers, working up to 4000 horse-power normal and 6600 with forced draught, and the nominal corresponding speeds are 18 and 20 knots, but it is hoped the latter will be exceeded. The bunker capacity is 226 tons, giving a range of 3000 miles at 10 knots and 600 miles at full speed. The complement of the cruiser will be 11 officers and 287 men.

The D'Assas and the Cassard.

These two second-class protected cruisers, sisters to the Duchayla, have been successfully launched, the D'Assas at Saint Lazaire, and the Cassard at Cherbourg. These three vessels were designed by M. Lhomme. Dimensions: Displacement, 3592 metric tons; length, 325 ft. 6 in.; beam, 44 ft. 10 in.; extreme draught, 20 ft. 5 in. The protection consists of a steel deck, having a maximum thickness of 2.3 in., and hardened steel shields to the guns. These are six 6.4-in., four 3.9-in., ten 1.8-in., and eleven 1.4-in. quick-firers, with two above-water torpedo-tubes. Two sets of vertical triple-expansion engines, supplied by D'Allest boilers, are to develop 9500 indicated horse-power, giving a speed of 19.25 knots. The coal capacity is 614 tons, sufficing for 6000 miles at 10 knots, and for 1000 miles at full speed. Complement will be 22 officers and 371 men.

Submarine Boats.

The Minister of Marine has taken up seriously the question of submarine boats, and has offered a series of prizes for the best design for such a vessel. The displacement is not to exceed 200 tons, the surface speed is to be 12 knots, and the vessel must be able to go 100 miles at a speed of 8 knots, and also to maintain a speed of 8 knots under water for 10 miles. Two torpedoes ready for launching must also be carried. The designs will become the property of the Government. Full details and complete plans are to be sent in, which must also show the basis on which stability, form of the vessel, motive power, etc., have been calculated. The first prize will be 10,000 francs.

Accidents on board the Duperré and Jauréguiberry.

[Engineer.]

An alarming explosion occurred on May 14th on board the French ironclad Admiral Duperré. A loud report was heard and the after part of the vessel was soon filled with thick smoke, which was found to be issuing from the central powder magazine on the lower deck. The door of the magazine was hurled a distance of 30 ft., and investigation showed that a cartridge about 13 in. long had exploded, but that none of the other cartridges among which it was packed were discharged. The magazine contained 3000 kilogrammes of gunpowder and mélinite shells, none of which were disturbed in any way. The explosion is attributed to the overheating of the magazine by pipes from the boilers.

[Engineering.]

The ironclad Jauréguiberry, perhaps the finest boat in the French navy, went for her 24 hours' trial off Toulon on June 9. Up to the 20th hour

the trip proved most successful, a speed of over 17 knots being maintained without difficulty, and the 24 water-tube boilers, which are of the Lagrafel-d'Allest type, gave absolutely no indication of anything wrong. The fires had just been cleaned when a sound of explosion was heard in boiler No. 1. This was quickly followed by a rush of steam and flame from the furnace fronts, the doors being forced open, and before they could escape, nine stokers were so severely scalded that six died within a few hours of the accident. As soon as possible the injured boiler was isolated from its fellows by the courageous action of a foreman from the Forges et Chantiers de la Mediterranée, and later on it was examined with a view to discovering the nature of the accident. The Lagrafel-d'Allest boiler may, in principle, be described as a gigantic locomotive fire-box, in which inclined water-tubes cross the furnace from one side to the other above the grate. The water spaces between the internal and external fire-boxes are connected by means of these tubes, round which the flame passes on its way to the chimney. All the tubes are straight. After the accident it was found that one of these tubes had burst and drawn from the front tube-plate. A rush of water and steam took place from the opening thus formed, but probably if the damage had stopped here no very serious consequences might have resulted, but in addition it was found that no less than forty of the top tubes were bent, drawn from the tube-plate, thus affording a large means of exit to the scalding steam. Why these tubes should have yielded thus is not very apparent, unless the water-level had been allowed to get low. We may mention that a somewhat similar accident took place on the 20th ult. at Brest Harbor, when a boiler tube on one of the Niclausse boilers of the Friant gave way, scalding three stokers more or less severely.

[ITALY.]

THE CARLO ALBERTO.

[JOURNAL UNITED SERVICE INSTITUTION.]

The new first-class armored cruiser Carlo Alberto was launched at Spezia. She is a sister ship of the Vettor Pisani, which is in hand at Castellamare, and her dimensions are as follows: Length, 325 feet; beam, 59 feet, and with a displacement of 6500 tons, she has a mean draught of 22 feet 11 inches. She has an end-to-end belt of nickel steel from the Terni works, 6 inches thick, and a battery above protected with plating of the same thickness, extending more than a third of the ship's length. The battery is closed in with 2-inch steel athwartship bulkheads, and is provided with steel splinter-screens between the guns, and there is an over-all armored deck 1.4 inches thick. The ship has a double bottom, cofferdams filled with cellulose, and numerous water-tight compartments. The armament consists of twelve 5.9-inch Q. F. guns, of which eight are in the battery (four on a side) and four on the superstructure above at the corners of the armored casemate. On the superstructure also are six 4.7-inch Q. F. guns, two on each broadside, one forward and the other aft; and the smaller guns are ten of 2.2-inch and eight of 1.4-inch, of which several are for the tops of the two fighting-masts. The torpedo equipment consists of four broadside tubes and one in the bows. The machinery has been built by Messrs. Ansaldo. Two triple-expansion engines, developing together 13,000 H. P. with forced draught, are sup-

plied by eight boilers distributed in four compartments, and are to give a speed of 20 knots. The maximum coal supply will be 1000 tons, in addition to liquid fuel, and the complement of the ship will be 460 men.

It is proposed to lay down a 28-knot torpedo-boat destroyer of the Daring type, and two 24-knot sea-going torpedo-boats, two torpedo cruisers of the improved Caprera type of 1300 tons displacement and 23 knots speed, and an armored cruiser of between 8000 and 10,000 tons, with a speed of not less than 22 knots. These vessels will be built at Castellamare, where it is also proposed to lengthen the building slips 3 and 4. It is, however, doubtful how soon a beginning will be made with these ships, as it is now stated that the two new torpedo cruisers Principe di Napoli and Regina Margherita, the construction of which was sanctioned in the last budget, have not as yet been commenced, the money voted for them having been devoted instead to the campaign in Abyssinia. Progress, however, is to be made with the Agordat and Coatit, torpedo cruisers of 1313 tons, and which are to have a speed of 23 knots.

It is stated that Italy has four submarine boats now completed, and another on the stocks. France, however, claims to have made the furthest advances in this line, though even here the success has not been great, the highest speed yet recorded being only six to eight knots. Another great difficulty is that of seeing under water. Thus M. de Lanessan states that when he was some 20 feet under water on board the Goubel in Cherbourg Harbor, though he could see to read quite clearly, he could not distinguish the hulls of two vessels only some 10 feet to 12 feet away from him.

[RUSSIA.]

[UNITED SERVICE GAZETTE.]

On May 12th, in the presence of the Czar, two new war-ships, the Russia and the General-Admiral Apraxin, were successfully launched on the Neva. The cruiser Russia is the longest vessel ever launched on the Neva, and the largest Russian ship of the kind afloat. As a matter of fact, she ranks first only after the Powerful and Terrible, which are about 14,200 tons. The Russia is more or less a copy of the Rurik, but larger and more powerful. The Rurik is 426 feet long, with 10,933 tons displacement. The Russia is 464 feet between perpendiculars, with a displacement of 12,195 tons. Including the ram, the full length of the Russia is over 480 feet, and the greatest breadth over all is 68 feet. The Russia's coal-carrying capacity is 2500 tons. Her triple-expansion engines, made at the Baltic works, are 17,000 indicated horse-power, and her expected speed is 19 knots. The boilers, thirty in number, are of the Belleville type, made in France. The armor plates of the belt are made at the Carnegie mills in America. The cruiser has a double bottom and 149 water-tight compartments, and carries fourteen different boats, including steam launches. Her armament will consist of 8-inch, 6-inch, 75-millimeter, 47-millimeter, and 37-millimeter guns, besides torpedo apparatus.

The Russia, however, is to be followed by a still larger cruiser of similar type. It is intended to lay down one of 14,000 tons, which is to be the largest and most powerful cruiser in the world. The Rurik was answered in England by the building of the Terrible. The Russian rejoinder is the construction of the Russia and the larger one now pro-

jected, besides the two first-class ironclads laid down last year. The following are the particulars of the other ship launched on the same day, the Apraxin: Displacement, 4126 tons; length, 278 feet; beam, 52 feet; two triple-expansion engines, 5000 indicated horse-power. She will be armored for 177 feet of her length with plates 10 inches thick in the center of the vessel, gradually lessening in thickness towards the stem and stern. She will carry four 9-inch guns in revolving turrets, and twenty-two various rapid-firing guns, besides torpedoes, for which there are four dischargers.

A high record for ballistic efficiency was made by Carnegie armor plate at the Indian Head Proving Ground on Wednesday last. An 8-inch plate, representing 600 tons of armor for the cruiser Russia, under construction for the Russian government, was tested with remarkably good results. The group was accepted on the showing made, and in addition Capt. Mertwago recommended to his government that the group of armor yet to be manufactured be accepted without ballistic trial. This latter group comprises 200 tons. Some weeks ago, as we announced at the time, there was a test of a 5-inch plate, representing a group of 350 tons of armor, for the cruiser Russia, and this group was accepted. If the Russian government adopts Capt. Mertwago's recommendation that the remaining group of 200 tons be accepted without test, the entire order of 1150 tons for the Russia will be delivered in a very few months more. Naval attachés of foreign countries in Washington and representatives of the press will hereafter be excluded from trials at the Indian Head Proving Ground.

Georgie Pobedonosetz.

The latest addition to Russia's Black Sea fleet has recently satisfactorily completed her steam and gun trials at Sevastopol. The Georgie Pobedonosetz is a first-class battle-ship of 10,280 tons displacement, 320 feet in length, 69 feet beam, and mean draught of 26 feet 7 inches, speed 16½ knots. The bunkers are capable of carrying 700 tons of coal. The armament consists of six 12-inch 56-ton breech-loading guns of the Russian Krupp pattern, carried in three barbettes, two barbettes being placed abreast on the forward deck of the ship, each barbette carrying two guns, the remaining two guns being situated in a barbette upon the after deck. There are also seven 6-inch 6-ton breech-loading guns, eight 10-centimeter quick-firing, and six machine guns. The vital portions of the vessel are protected by a belt of 16-inch, and the barbettes by 12-inch compound armor plates. The propelling machinery is of the vertical inverted triple-expansion type, having cylinders 45 inches, 66 inches, and 100 inches in diameter, and common stroke of 4 feet, driving twin screws of 16 feet 6 inches diameter. Working steam pressure, 150 lbs. per square inch. Steam is supplied by 16 boilers arranged in four separate compartments. They are of the cylindrical single-ended type, having three furnaces each, the total grate area being 980 square feet, and total heating surface 29,100 square feet. Air is supplied by means of 12 double-breasted fans, each of 5 feet diameter. Upon May 21, at 8.30 A. M., the vessel left Sevastopol Harbor for official steam trial, the stipulated power being 10,060 horses, to be maintained for six consecutive hours with assisted draught, ½ inch air pressure in the stokeholds being the maximum allowed. The mean result of six hours' trial was 13,468 indicated horse-power. The result is considered highly satisfactory, the above-mentioned horse-power (nearly 3000 in excess of the contract) being main-

tained with ease by the ordinary ship's crew of Russian stokers and artificers, led by a small staff of Englishmen. The ship returned to harbor in the evening. Upon the following day the vessel again put out to sea for artillery trials, the results of which were highly satisfactory, both guns and mountings being thoroughly tested during a trial which lasted nearly 12 hours. The Georgie Pobedonosetz will now join her sister vessels Sinope, Catherine II., Tchesma, and Dvenatdset Apostoloff, forming together a fleet of five first-class battle-ships complete and equipped ready for service. The last ironclad launched in the Black Sea, viz., Tri Svilitela, awaits steam trials, which, however, will probably not take place during the current year.

THE KHERSON.

[JOURNAL ROYAL UNITED SERVICE INSTITUTION.]

On May 16th an official trial was made off the Tyne of the Russian volunteer fleet steamship Kherson, which has been built and engined by Messrs. R. & W. Hawthorn, Leslie & Co., of Newcastle-on-Tyne. This vessel, which is the thirteenth of the fleet, is arranged to carry an armament of seven 4.7 Q. F. guns and twenty others guns of smaller natures. These are kept in store at Odessa, to be shipped in case of war. She is a twin-screw vessel, 492 feet long and 54 feet 3 inches wide. The engines are of the triple-expansion type. The chief interest in the machinery department centers in the boilers. These are of the Belleville water-tube type, similar in construction to those which are being placed in the British cruisers Powerful and Terrible, now in course of completion. On a twelve hours' trial the Kherson made her contract speed of 19.5 knots, but the H. P. exceeded the estimate, the mean of the twelve hours being 13,150 I. H. P. The sea was rather rough, which detracted somewhat from the speed. The steam pressure of 250 lbs. was maintained with ease during the trial, although the stokers were quite unused to this type of boiler. The boilers were supplied by Messrs. Maudslay, Son & Field, of London.

[GERMANY.]

[JOURNAL OF THE ROYAL UNITED SERVICE INSTITUTION.]

The necessary votes having been approved by the Reichstag, the Ministry of Marine has accepted the tender of the Vulcan Yard at Stettin for the construction of the second-class cruiser N; the ship is to be completed in two years and a half. A cruiser of a similar type was commenced in October last year at the same yard, which is to be completed in twenty-five months from the date of commencement. It has also been decided that the new first-class battle-ship Ersatz Friedrich der Grosse is to be laid down at Wilhelmshaven, and the second-class cruiser M at the imperial dockyard at Danzig. The fourth-class cruiser G is also to be built at a private yard, but the contract has not yet been given out. Altogether there are under construction or to be commenced in the Imperial dockyards the two first-class battle-ships Ersatz Preussen and Ersatz Friedrich der Grosse, the first-class armored-cruiser Ersatz Leipzig and the two second-class cruisers Ersatz Freya and M; while in private yards are already building or to be commenced three second-class cruisers K, L, and N, and the fourth-class cruiser G. According to present

arrangements, it is hoped that the launch of the first of these ships, one of the cruisers, will take place in the autumn. Each of the five new cruisers is to have three screws, the engines being in separate compartments; the I. H. P. to be developed is 10,000, giving a speed of 22 knots. The guns are to be in 4-inch armored casemates, and the armored deck will also be 4 inches thick.

Coaling Station.

The Ministry of Marine has determined to construct a large coaling station at the eastern entrance to the Kaiser-Wilhelm Canal, and the necessary works are to be commenced this summer; the coal depot is to be 566 feet long, with a depth of 68 feet, and will be placed on the south bank of the entrance to the canal and immediately adjoining the new torpedo-boat harbor; it will be connected by rails with a mole 890 feet long, the water alongside which will be of sufficient depth to allow the largest battle-ship to come alongside and take in her coal. Hydraulic cranes are to be provided. The whole work is to be completed in two years. A similar coaling station is to be constructed at the Bruisbuttel harbor, at the west entrance of the canal. At both depots 77,000 tons of coal are to be stored.

[Austria.]

The Buda Pest.

[Royal United Service Institution.]

On April 27 the new coast-defense battle-ship Buda-Pest was launched from the Stabilimento Tecnico Triestino at San Rocco, near Trieste. The principal dimensions of the ship are as follows: Length, 303 feet 6 inches; beam, 55 feet 3 inches; displacement, 5550 tons; mean draught, 20 feet 6 inches. The hull of the ship is constructed of Siemens-Martin steel, divided into the usual cellular and water-tight compartments, while the pumps will be sufficiently powerful to discharge 1500 tons of water hourly in case of necessity. Protection is afforded by an armor belt of 10.8-inch nickel steel, made by the Austrian firm of Witkowitz & Co., tapering to 8 inches aft and 5 inches forward, which runs from the ram for five-sixths the length of the ship, extending from 3 feet 6 inches below to 3 feet 6 inches above the water-line at normal draught, the after ends being joined by an 8-inch armored athwartships bulkhead. On the top of the belt runs fore and aft the whole length of the ship a 1.8-inch armored deck, rising, above which, and extending from the after end of the armored belt for about two-thirds of the ship forward, is a citadel protected with 3.3-inch armor, with transverse bulkheads of the same thickness of plating. Above again, on the upper deck, is a smaller citadel, also protected with 3.3-inch armor, fore and abaft which, but with their basis protected by the armored lower citadel, are the two barbettes for the heavy guns, plated with 8-inch armor and fitted with 2.5-inch steel hoods for the guns. There are, further, two conning towers, the foremost with 8-inch plating, the after with 2.5-inch. The whole weight of the armor amounts to 1700 tons. The armament consists of four 24-centimeter (9.4-inch) 40-caliber long Krupp guns, mounted in pairs in the barbettes. Each gun weighs 26 tons, and the mountings for each pair of guns, including the hood, 123 tons. The armor-piercing projectile,

which weighs 474 lbs., has an initial velocity of 2275 feet, and, with an elevation of 22°, has a range of 16 kilometers (10 miles). The secondary battery consists of six 15-centimeter (5.8-inch) Q. F. guns, two 7-centimeter Uchatius guns for boat and landing purpcses, sixteen 3-pounder Q. F. guns, and two mitrailleuses with broadside torpedo-tubes. The six 15-centimeter Q. F. guns are mounted in the citadel on the upper deck, two firing from right ahead to 70 abaft the beam and two from right aft to 70 before the beam; the other two are on the broadside. The guns are separated from each other by steel splinter-proof bulkheads. Ten of the 3-pounder Q. F. guns are mounted on the superstructure over the upper citadel. The guns, barbettes, and ammunition hoists are all to be worked by electricity, the ammunition for the heavy guns and secondary battery being provided through separate armored tubes. The engines are intended to develop 6000 I. H. P. under natural draught, giving a speed of 16 knots, and 8500 I. H. P. under forced draught, the corresponding speed being 17.5 knots. The coal capacity is 500 tons, giving a cruising radius of 3000 miles at 10 knots.

[SPAIN.]

THE VILLALOBOS.

[MARINE RUNDSCHAU.]

The Spanish gunboat Villalobos, sister ship of the Quiros, was launched at Hong Kong. The gunboat is destined for service in the Philippine Islands. She carries two R. F. guns and 2 machine guns. Displacement 315 tons, 300 I. H. P.

THE ALMIRANTE OQUENDO.

The cruiser Almirante Oquendo has had a successful trial trip at Bilboa. With natural draught and 105 revolutions, the engines developed 9000 I. H. P., giving a mean speed for six hours of 18.4 knots. With forced draught and 117 revolutions, 13,000 I. H. P. was developed, with an average speed of 20.3 knots. The Oquendo is the last of the three armored cruisers built at Bilbao; the two sister ships are the Infanta Maria Teresa and Vizcaya. The following are the dimensions: Length, 364 feet; beam, 65 feet; draught, 21 feet 6 inches; displacement, 7000 tons. Armor: waterline belt, 315 feet long, of 10 to 12 inches of steel; turrets 9 inches, conning tower 12 inches, protective deck 2 to 3 inches, ammunition tubes 8 inches. Armament: two 11-inch Hontoria guns, one forward, one aft, singly in turrets; ten 5.5-inch R. F., and twenty-two smaller caliber R. F. and machine guns, with eight torpedo-tubes, two being submerged.

[DENMARK.]

[ENGINEER.]

The Danish ironclad Skjold was recently launched from the Royal Dockyard, Copenhagen, in the presence of the King and Queen of Denmark and a distinguished gathering. The displacement is 2156 tons; she has twin propellers, and the engines are calculated to give 2200 indicated horse-power. The length is 221 feet and breadth 37 feet. The Skjold is built of steel, and has 51 water-tight compartments, besides the compart-

ments in the double bottom. The armor extends from 3½ feet below to 3 feet above the water-line, and consists of 9-inch Harvey steel, decreasing down to 7 inches towards the ends of the ship. The turret armor is 8 inches, and there is a protective armor deck, 2 inches, over the whole of the ship. The armament consists of a 9-inch, about 25-ton, breech-loading gun, in the turret; three 5-inch rapid-firing guns, in three small turrets, each protected by 5-inch armor; four smaller rapid-firing guns and two mitrailleuses. The Skjold will be fitted with electric working appliances for the working of the turrets and for the handling of the ammunition.

[JAPAN.]

THE FUJI.

[THE ENGINEER.]

The Japanese war vessel launched on Tuesday, March 31, from the Thames Ironworks and Shipbuilding Company is named the Fuji, or "Unequalled," and the following are a few of the principal features of her design: Length between perpendiculars, 374 feet; breadth, 73 feet; draught of water, 26 feet 6 inches; displacement, 12,450 tons; coals at this draught, 700 tons; total capacity, 1300 tons.

The original inquiry in 1883, through Admiral Ito, was for an improved Collingwood, but the displacement tonnage was to be limited to 8000 or 8500 tons, and seeing it was difficult to improve on a Collingwood with 1500 tons less weight, the necessity of a larger tonnage soon became evident, and a limit was then given of 10,500 tons, or a Centurion type; but as it was required to carry a heavier armament than that vessel, a still larger tonnage became necessary, resulting in a vessel of 12,450 tons, of the Royal Sovereign type, as above. The Fuji has an armor belt 226 feet long, 18 inches thick through machinery and boiler spaces, and 16 inches at ends; two barbettes, armor-plated with 14-inch armor, and standing upon the armor deck. A screen of 6-inch armor runs across on the main deck, as well as on the lower deck, to protect the broadside 6-inch quick-firing guns from a raking fire; also a belt of 4-inch armor on 2-inch teak backing between main and lower decks of about the same length as the main belt.

The barbettes carry two 12-inch breech-loading guns in each, with armored shields 6 inches thick, also ten 6-inch quick-firing guns, four of which are in casemates and the other six on the upper deck, and protected by heavy shields; twenty 3-pounder Hotchkiss quick-firing guns, four 2½-pounder Hotchkiss quick-firing guns, and five 18-inch torpedo ejectors, one above water and four below.

The armor deck extending from stem to stern is 2½ inches thick, and terminates in a powerful ram at the fore end. The decks are of teak. There are two military masts with double tops, with derricks for lifting the boats in and out from off the skid beams. Thirteen boats in all are to be carried, including two 56-feet vidette boats, navy pattern. Five search-lights, and the whole of the vessel to be lighted internally by electricity. The conning tower is 14 inches thick, and the director tower aft 3 inches thick.

In view of the disastrous effects of the shell fire from the machine guns, as witnessed in the late war with China, all woodwork is substituted by steel and other metal wherever possible. The seamen's mess-shelves, and

also other fittings, as the bulkheads of the saloons and cabins, are all of steel and brass. The engines, which are triple expansion, of 14,000 horse-power, are constructed by Messrs. Humphrys, Tennant & Co., of Deptford, the boilers being of the usual cylindrical type. Speed, 18¾ knots. The vessel has been designed by Mr. George C. Mackrow, naval architect of the Thames Ironworks and Shipbuilding Company.

Good progress is now being made with her construction, as upon the cessation of hostilities with China it was suggested by the Japanese Government that the time of completion should be shortened, and the past few months have made a very material change in her general appearance on the slip, otherwise the delivery was not required for five or six years, so that twelve months' time has been lost. Some 7300 tons of material are in her, including 1600 tons of Harveyed armor, some of which plates weigh 28 tons and cost £2870 each. The armor for the hull has been made by Messrs. Vickers & Son, of Sheffield, and the nickel casemate armor by Messrs. William Beardmore & Co.

The construction of the vessel is under the superintendence of Captain Takayama, that of the engines under Captain Miyabara, that of the armament under Lieutenant Kitakoga, while Captain Yendo, who is also Naval Attaché to the Imperial Japanese Embassy, is the chief of the Commission. The Thames Ironworks find, however, that they are entering upon a new experience in fitting out this large vessel and adapting and fitting all the multitudinous departments to the requirements of their clients in the far East. In Europe, methods of feeding and systems of carrying provision for crew and officers are fairly uniform, barrels and cases being of pretty general proportions, but the Japanese provisions are stowed in barrels, conical shape, something like our harness casks, and most inconvenient for stowing, as the larger diameter is at the top, and not at the bottom, as with us, so that each barrel or cask has to have its allotted place, and consequently there is a great loss in stowage.

[Deutsche Heereszeitung.]

The ship-building programme contemplates the expenditure of 240 million marks, to be extended over a period of several years. According to this programme there will be built four battle-ships, nine protected cruisers (four 1st class, three 2nd class, two 3rd class), three torpedo cruisers, one torpedo transport ship, arranged to carry six torpedo-boats, eleven torpedo-boat destroyers, twenty-three torpedo-boats 1st class, thirty-one 2nd class, and thirty-five 3rd class.

The battle-ships will be of 15,140 tons displacement; the armament to consist of four 11.8-inch guns arranged in pairs in barbette turrets, twelve 5.9-inch R. F. guns, about thirty guns of smaller calibers; also five torpedo-tubes, four of which are under water. Speed to be 17.5 knots.

The cruisers 1st class to be of 7500 tons displacement, with a speed of 21 knots, armed with two 9-inch, ten 5.9-inch R. F., and twelve 2.6-inch guns. The cruisers 2nd class are to be enlarged Yoshimos of 4870 tons, with a speed of 22.5 knots, armed with rapid-fire guns, viz., four 5.9-inch, eight 4.7-inch, and a number of guns of smaller calibers. The 3rd class cruisers of 3200 tons and the torpedo-cruisers of 1200 tons to have a speed of 21 knots; armament of four 4.7-inch and four 2.6-inch R. F. guns. The torpedo-transport, of 6750 tons, to have a speed of 21 knots. The following are the displacements and speeds for the torpedo vessels:

Torpedo-boat destroyers 254 tons, 30 knots; 1st class torpedo-boats 120 tons, 24 knots; 2nd class torpedo-boats 84 tons, 22 knots; 3rd class torpedo-boats 54 tons; torpedo-boats on board the transport 11½ tons. Three battle-ships, two 1st class cruisers, one 2nd class cruiser, the torpedo-cruisers, the transport with its six boats, four destroyers, four 1st class and several of the 2nd class torpedo-boats to be built in Europe, the others to be built in Japan.

[CHILE.]

THE ESMERALDA.

[ENGINEERING.]

The Esmeralda, cruiser, built for the republic of Chile by Sir W. G. Armstrong & Co., Newcastle-on-Tyne, was launched on May 15. The principal dimensions, etc., of the vessel are as follows: Length between perpendiculars, 436 feet; extreme breadth, 53 feet 2 inches; draught (mean), 20 feet 6 inches; displacement, 7000 tons. The vessel is flush-decked, built entirely of steel, sheathed with wood, and coppered. All her machinery, magazines, and steering gear are kept entirely below the curved steel protective deck, which varies in thickness from 1½ inches in wake of the armor belt to 2 inches at the ends. She is also provided with an armor belt 7 feet wide, extending over about 350 feet of her length, and having a thickness of 6 inches. At the ends of the belt there is a 6-inch transverse bulkhead. The coal bunkers are situated above the protective deck, and when filled with coal will add materially to the water-line protection of the ship. Space is provided in the vessel for 1200 tons of coal at the load draught. Her armament is composed entirely of Elswick quick-firers, and is as follows: Two 8-inch with heavy shields, placed one forward and one aft, and each having about 270 degrees of training; sixteen 6-inch, four of which are placed on the bridges forward and aft, and twelve on the upper deck, four of them firing right ahead and four right astern, while eight can train on each broadside. The auxiliary armament consists of eight 12-pounders, ten 6-pounders, and four Maxims, placed in advantageous positions. In addition she carries three torpedo-tubes, one fitted in the stem above water and two submerged on the broadsides. It is estimated that she will have a speed of 22¼ knots with natural draught.

THE ALMIRANTE SIMPSON.

[JOURNAL ROYAL UNITED SERVICE INSTITUTION.]

A new torpedo-gunboat, the Almirante Simpson, was also launched from the yard of Messrs. Laird & Co., at Birkenhead. The vessel is an improvement on the Almirante Lynch, built by the same builders for Chili some years back, and the Onyx, built for the British navy. The dimensions are: Length, 240 feet; beam, 27 feet 6 inches; draught, 10 feet 6 inches, with 800 tons displacement. The armament consists of one bow and two broadside torpedo-tubes for 18-inch torpedoes, two Armstrong 4.7-inch Q. F. guns, and four Maxim-Nordenfeldt 3-pounders. The machinery consists of twin-screw triple-expansion engines of 4500 I. H. P. The boilers are of the Normand water-tube type, with a pressure of 200 lbs. The estimated speed is 21 knots. The range of action at 10 to 11 knots speed is about 4000 knots. The plating of the sides and deck for the length of the machinery space is increased in thickness to afford protection to the engines.

THE TENIENTE SERRANO.

On the 16th of May was launched at Birkenhead, from the works of Messrs. Laird Brothers, the new torpedo-boat destroyer Teniente Serrano, the third of the four building by this firm for the Government. These vessels are 210 feet long, with a beam of 21 feet 6 inches; the engines are to develop 6000 I. H. P., giving a speed of 30 knots. This is the seventh 30-knot destroyer launched during the last eight months by Messrs. Laird.

Six first-class torpedo-boats are being built by Messrs. Yarrow & Co.; they are 152 feet 6 inches in length by 15 feet 3 inches beam, and will be propelled by triple-expansion engines, to give a guaranteed speed of 25½ knots. The bunker capacity is 40 tons, which will give a very large range of action. The I. H. P. will be about 2000, and they will be an improvement on the Viper, which vessel was lately built by the firm for the Austrian navy. This vessel, it will be remembered, attained a speed for three hours of 26.6 knots, with a consumption of 1.9 lbs. of Welsh coal per I. H. P. per hour, with an air pressure of ⅞ of an inch in the stokehold.

[ARGENTINE.]

THE VARESE.

[MILITÄR WOCHENBLATT.]

The Italian armored cruiser Varese, building at Leghorn, has been purchased by the Argentine government. The dimensions of the Varese are as follows: Length, 328 feet; breadth, 59 feet; draught, 23 feet; displacement, 6840 tons. Complete nickel steel armor belt of 6 inches, above it for ⅔ of ship's length to height of upper deck 6 inches, 6-inch bulkheads protecting base of barbettes. Two 6-inch barbette turrets. Deck above battery 1.9 inches, protective deck .8 to 1.5 inches. There are eight cylindrical boilers, two triple-expansion engines, twin screws. With forced draught and 13,400 H. P., speed of 20 knots. Coal capacity 1000 tons, besides liquid fuel in double bottoms. Armament: Two 10-inch B. L. R's, ten 6-inch, six 4.7-inch, ten 6-pounder, ten 1-pounder R. F. guns, all fitted with gun-shields, besides two machine guns and five torpedo-tubes. The Garibaldi, purchased last year, was renamed the San Martin, and it is probable that the Varese will also be renamed.

TORPEDO BOAT DESTROYERS.

[ENGINEERING.]

On Saturday afternoon last, May 16, there was launched from the yard of Messrs. Yarrow & Co., at Poplar, a torpedo-boat destroyer, which differs somewhat from vessels of this class built for the British navy, chiefly in respect of being armored.

The boat in question is one of four similar vessels now in course of construction at Poplar. Her length over all is 190 feet 8 inches, her breadth 19 feet 6 inches, and her depth amidships 12 feet. With a draught of 5 feet the displacement will be about 250 tons. The machinery consists of two sets of triple-expansion engines of the type usually placed in torpedo craft by this firm. The cylinders are 18 inches, 26 inches, and

39½ inches in diameter by 18 inches stroke. There are two condensers, and the usual auxiliary engines for steering, electric light, distilling, air compressors, etc. There are six boilers of the Yarrow water-tube type, capable collectively of supplying steam for 4000 indicated horse-power. The weight of each of these boilers is 6¾ tons with water and fittings. The propellers are of manganese bronze, each with three blades, and are 7 feet in diameter by 8 feet pitch.

The armament comprises one 18-inch torpedo-tube, built into the stem for bow fire, and two 18-inch swivel torpedo-tubes on deck aft. The latter command both sides of the vessel. There will be a 14-pounder quick-firing gun mounted on the conning tower forward, three 6-pounder quick-firing guns on the deck aft, and two Maxim automatic guns just abaft the conning tower, one being on either side.

For feeding the boilers, the new system adopted by this firm has been fitted. There is in the engine-room a main feed pumping engine, which takes water from the hot-well and pumps it into a large cylindrical vessel at a pressure of 30 lbs. to the square inch. Across this vessel are stretched diaphragms of flannel through which all the water going to the boilers has to pass, in order to abstract grease. Leading from this vessel is a single-feed main, which runs the length of the boiler compartments. To each of the six boilers there is a separate feed pump which has its suction from the feed main. The steam pipe to the separate feed pump is taken from its boiler at a point about the normal water-level, there being, however, an interval swivelling pipe by which the level can be altered if necessary. If the boilers become too full, water, in place of steam, flows into the steam pipe. The pump steam cylinder thus becomes choked, and the action of the pump is all but stopped. When the water-level falls again, through evaporation taking place in the boiler, steam once more passes to the pumping engine, which thus recommences its proper functions. The exhaust from the pumps is not taken to the condenser, but into the feed main.

The policy of armoring these small craft has been a good deal discussed lately, the interest in the subject having been revived by some operations during the late war in the East. About 11 years ago Messrs. Yarrow & Co. built for the Japanese Government a small vessel, the Kotaka, which was protected by armor, and was, we believe, the first high-speed armored torpedo craft. It will be remembered that during the late war the Kotaka led two important torpedo attacks, and came through comparatively unharmed, whilst the unarmored boats suffered severely. The price paid by armor is, of course, loss of speed, but the Argentine naval authorities are evidently of opinion that it is advisable to sacrifice something in swiftness in order to gain protection. In our own navy there are, as stated, no armored torpedo craft, it being held that the very thin armor, which alone can be used, is comparatively useless, or worse than useless, whilst it destroys the most valuable quality in these little vessels—their paramount speed. Speed, however, is a relative term. These Argentine destroyers are to steam 26 knots, which would be sufficient to enable them to perform their ostensible duty of putting out of action torpedo-boats proper. It is now generally recognized, however, that "destroyers" are but torpedo-boats of a larger growth, and this is fairly well shown by the fact that the present vessels have each three torpedo discharges, which are certainly not intended for use against small craft. Whatever may be the intention of the designers,

however, one may be sure that no naval officer in command of a destroyer would lose the opportunity of bagging a battle-ship or cruiser. For such an opportunity the chief advantage of speed is that it enables the attacking boat to pass "the zone of fire" very quickly. Armor naturally lessens this advantage, but whilst it detains a boat longer under fire, it would keep out a great many projectiles that might otherwise prove fatal. It is, of course, guns of the smaller natures that torpedo craft have most to fear. The very limited target they present warrants them in taking their chance of a blow from the larger and comparatively slower firing weapons. In any case no protection could be provided against these. The machine gun sends a stream of bullets which may almost be likened to a jet of water from a hose, and, once the range were obtained, would soon play havoc with the ordinary thin plating of the average torpedo-boat. It is to keep out these projectiles that ½-inch armor has been added to the Argentine boats. This armor entirely surrounds the engines and boilers, the bulkheads at the ends of the machinery space being also of steel ½ inch thick. The estimated speed of these boats, 26 knots, may be compared with the 30 knots of the unarmored destroyer Sokol, built by Messrs. Yarrow. The Russian boat, however, though the same length, was a foot narrower, and, moreover, was built of a special steel which enabled the scantling to be lightened.

Messrs. Yarrow have at present a very full yard, the whole of the work being done for foreign governments. There is in course of construction, in addition to the four Argentine destroyers, a large stern-wheel boat for the Russian Government, a twin-screw gunboat for Brazil, and six first-class torpedo-boats for the Chilian navy, besides some smaller craft. At the present time we learn there are about 1100 men employed at the Poplar yard in the construction of these small war vessels.

[BRAZIL.]

BRAZILIAN WARSHIP BUILDING NOTES.

[MITTHEILUNGEN AUS DEM GEBIETE DES SEEWESENS.]

The following war-ships are building: Two battle-ships in France, three torpedo-cruisers and three first-class torpedo-boats in Germany, and two monitors in Brazil.

THE CARAMURA.

The torpedo-cruiser Caramura was launched at Kiel, April 1. The principal dimensions are: Length, 79 ms.; beam, 9.4 ms.; draught, 3.1 ms.; displacement, 1030 tons. Two triple-expansion engines with 6000 I. H. P. to give a speed of 23 knots. Armament: Two 10.5-cm. R. F., six 5.7-cm., and four 3.7-cm. Nordenfeldt R. F. guns; two 45-cm. broadside and one bow torpedo-tubes.

[SAN DOMINGO.]

GUNBOAT RESTAURACION.

Messrs. Napier, Shanks & Bell, Yoker, launched on the 15th inst. the twin-screw gunboat Restauracion, which has been built by them to the order of Messrs. Frame, Alston & Co., London, for the government of

San Domingo. The vessel, which has very fine lines, ram bow, and gunboat stern, is the second constructed by the same builders for the republic; but the new vessel differs from her predecessor, the Independencia, in being larger in size and with greater speed, and otherwise better adapted for war purposes, having barbettes fitted on the sides mounted with Hotchkiss quick-firing guns, similar guns being also mounted at the bow and stern. The Restauracion is 214 feet over all by 30 feet beam. Rooms are provided for the President and his suite, besides accommodation for officers and artillerymen. The machinery is being fitted by Messrs. Dunsmuir & Jackson.

BOOK NOTICES AND BOOKS RECEIVED.

A TEXT-BOOK OF ORDNANCE AND GUNNERY, prepared for the use of Cadets of the U. S. Military Academy. By Captain Lawrence L. Bruff, Ordnance Dept., U. S. Army. Published by John Wiley & Sons.

In the preface to this volume of 675 pages the author states that "the present text-book has been compiled with the object of presenting as clearly as possible the elementary principles of the course in Ordnance and Gunnery as taught at the Military Academy, and of so arranging it that it can be readily used for recitations in the section-room. . . ."

The contents are arranged in chapters as follows: I. Gunpowder and Interior Ballistics; II. High Explosives and Smokeless Powders; III. Guns; IV. Projectiles and Armor; V. Fuzes and Primers; VI. Exterior Ballistics; VII. Artillery Carriages; Theory of Recoil; VIII. Pointing; Probability of Fire; IX. Portable Arms; X. Machine and Rapid-fire Guns. Index. H. G. D.

HAND-BOOK ON NAVAL GUNNERY, by Cyrus S. Radford, Lieut., U. S. Marines; revised and enlarged with the assistance of Stokely Morgan, Lieut., U. S. Navy. Published by D. Van Nostrand Company, New York.

The revised second edition of this excellent manual is well up to date. The book has already proven so useful that a frank criticism of the errors of the present edition can do it no injury.

A serious blunder is made on page 19, where the Fletcher (modified Farcot) breech mechanism for large b. l. guns is correctly described, but illustrated (with lettered references) by a plate of the older and quite different mechanism which it has supplanted.

The new telescope sight is well discussed on pages 38 and 39, but the answer in regard to compensation for drift is a little misleading, for the permanent angle of inclination of trunnions will differ in different guns, as it now does for their sight-bars.

A misnomer occurs on page 54, where an 8-inch turret mount is called a rapid-fire mount.

The statement on page 82 that 53-mm. H. R. C's are to be found on board ship might lead to the belief that there are some 53's in the U. S. Navy, whereas there are none.

It is stated in error on page 120 that brown prismatic powder grains are the same size for all calibers. The forms of smokeless powder grains described on page 123 have been discarded in favor of flat strips.

The catechism on automobile torpedoes should be rewritten, now that the Bureau of Ordnance publications upon those weapons are available.

As evidences of careful attention to progress, there will be found in this edition a description of the Fletcher rapid-fire breech mechanism and of the new electric primers, with illustrations of each.

The hand-book is to be furnished to all ships' libraries, and has been issued to officers and non-commissioned officers of the U. S. Marine Corps and of the Naval Reserve. Considering its wide field among the latter, a chapter upon arming and equipping boats and a good cutlass drill might be profitably added. J. M. E.

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APRIL 10. Assistant Engineers in the Royal Navy. The Causes of Mysterious Fractures in the Steel used by Marine Engineers as revealed by the Microscope (illustrated). Measurement of Feed and Circulating Water, etc., by Chemical Means (illustrated).

APRIL 17. Naval Architecture. A Few Principles Popularly Explained. Engineers in the Royal Naval Reserves.

APRIL 24. Launch of a Torpedo Gun-vessel for Chili. Formulae for calculating the Perforation of Armor (illustrated). Testing Steel Boiler Plates in the United States.

MAY 1. Naval Architecture. A Few Principles Popularly Explained: No. VI. Tonnage and Freeboard (illustrated). The North Pole Balloon.

MAY 15. Auxiliary Engines in Screw Steamers. Wheeler-Sterling Projectiles. Breech Mechanism of the U. S. 13-inch Breech-loading Gun (illustrated). The Bazin Disk-wheel Steamboat (illustrated).

MAY 22. The Problem of Speed. Armored Torpedo-boat Destroyers for the Argentine Republic (illustrated). The Channel Squadron.

JUNE 5. Maritime Canal on the Lower Loire. The Vulcan Works, Stettin (illustrated). Professor Elisha Gray's Telautograph (illustrated).

JUNE 12. The National Electrical Exhibition at New York (illustrated). The Barry Docks (illustrated). Development in Design and Construction of German Men-of-war (illustrated). The Vulcan Works, Stettin (illustrated). The Sundale Packing Block (illustrated). The Shipyard and Floating Docks of Messrs. Blohm and Voss, Hamburg-Steinwarder. Ship-building in Germany.

JUNE 19. The Institution of Naval Architects in Germany. New Destroyers now Building. The Boilers of Torpedo-boat Destroyers. Recent Improvements in Docks and Docking Appliances (illustrated). Use of Electricity on board Ships.

ENGINEERING.

APRIL 3, 1896. Compound Marine Boilers. Classification of War-ships. Losses in Battle. Royal Armor-clad Sicilia.

APRIL 10. The French Torpedo-boat Forban. H. M. S. Renown. H. M. S. Ranger. Some Geometry in connection with Stability of Ships.

APRIL 17. Barbette Carriage for U. S. 12-inch B. L. R.

APRIL 24. The New Royal Observatory. H. M. S. Desperate.

MAY 1. Canet Automatic Breech Mechanism for Quick-firing Guns.

MAY 15. Coast and Lighthouse Illumination in France (illustrated). The Argentine Cruiser Buenos Aires (illustrated).

MAY 22. Expanding Boiler Tubes by Power (illustrated). Mineral Oil in Marine Boilers. The Russian Auxiliary Cruiser Kherson. Torpedo-boat Destroyers for the Argentine Navy. The Non-uniform Rolling of Ships (illustrated).

MAY 29. The Argentine Cruiser Buenos Aires (illustrated). The Non-uniform Rolling of Ships. Circulating Water, etc., by Chemical Means (illustrated).

JUNE 5. Coast and Lighthouse Illumination in France (illustrated). The Design of War-ships. Our Naval Position. Spring-loaded Check Valves for Steam Boilers.

JUNE 12. Our New Cruisers (illustrated). The Institution of Naval Architects. Ship-building in Germany.

JUNE 19. Coast and Lighthouse Illumination in France (illustrated). Naval Range Finder (illustrated). The Design of War-ships. German War Vessels (illustrated).

PROCEEDINGS OF THE ROYAL ARTILLERY INSTITUTION.

APRIL, 1896. A Plea for Indirect Fire. The Influence of Ammunition on Shooting. Bayard's Armor.

MAY. Garrison Artillery Warfare. Artillery and Musketry Fire. The Battle of Austerlitz. The Causes of Drift of Elongated Projectiles Fired from Rifled Guns.

JUNE. Artillery from an Infantry Officer's Point of View. Master-General of the Ordnance in Ireland. Revue Militaire de l'Etranger. Firing at Captive Balloons.

UNITED SERVICE GAZETTE.

MARCH 28, 1896. Naval Warfare of the Future. American Appreciation of Submarine Boats.

APRIL 4. Naval Warrant Officers. An American's Warning. The Present Infantry Sword Exercise.

APRIL 11. Control of War-ships in Action.

APRIL 25. Naval Notes. Manning the Navy.

MAY 2. A Plea for Indirect Fire. A Steady Platform at Sea. High-pressure Guns.

MAY 9. The Naval Reserve. Naval Training. Entry, Training, and Distribution of the Personnel of the Navy.

MAY 16. Pistols. Surgeons in the Navy. The Development of the Pistol. Religion in the Navy.

MAY 23. The Naval Pay System. The Edgar Disaster. Armament of War-ships.

MAY 30. The Protection of Steel and Iron Surfaces. Belligerency in Connection with Naval Warfare. Value of Torpedo-boats.

JUNE 6. The Defense of the Empire-Functions of the Army and Navy. A Homogeneous Fleet versus Specialized War-ships.

JUNE 13. Test of an Experimental Turret. War-ship Construction.

JUNE 20. Condensed Rations in War. Naval Notes. The Navy League and the Manning of the Fleet.

THE STEAMSHIP.

APRIL, 1896. Marine Boiler Explosion. Liquid Fuel and Methods of Burning it. Launch of a Japanese Battle-ship at Elswick. Stokehold Temperature in Ships. The New Third-class Cruiser for H. M. Navy. The Navy Estimates.

MAY. Trial of Baxter's Steam Steering Gear (illustrated). Marine Boiler Explosions. The Latest Invention for Sailing Ships. The First-class Japanese Battle-ship Fuji (illustrated). Launch of the Battle-ship Mars. Launch of a P. and O. Steamer at Greenock. New Water-tight Bulkhead Door. Nelson's Old Flagship Foudroyant.

JUNE. Marine Boiler Explosions. A New Departure in Marine Engineering. The Value of the Steam Jacket.

MARINE RUNDSCHAU.

APRIL, 1896. The Concentration of the French Fleet in the English Channel, 1803 to 1805, planned by Napoleon. The Behavior of Torpedo-boats in Heavy Seas. A Test of Dillingen 6-inch Face-hardened Armor Plates. Protection against Collisions. Old Books on Naval Architecture. Foreign Naval Notes.

MAY. Gunboats of 1859. Calculating Ship's Position at Sea. Trial Trips of H. M. S. Geier. The Volunteer Fleet. Trafalgar. Foreign Naval Notes.

JUNE. Impressions in German East Africa. On Poisoning Cases on board Ship due to Spoiled Provisions. Properties of Aluminum, and its Application for Engine and Ship Construction. Trafalgar (continued). Foreign Naval Notes.

MITTHEILUNGEN AUS DEM GEBIETE DES SEEWESENS.

Vol. XXIV., No. 5. The Influence of the Adriatic upon the History of the People of Central Europe. A New Compass. Circulation in Water-tube Boilers. Foreign Navies in 1895. The English Torpedo-boat Destroyer Desperate. England's Naval Budget, 1896 to 1897. Foreign Navies.

No. 6. The Brown Segmental Wire-wound Gun. Foreign Navies in 1895 (conclusion). The Italian First-class Battle-ships. Canet Turrets with Electric Training Gear. Holland Submarine Boat. Foreign Navies.

No. 7. Solution of Nautical Astronomical Problems by the Tables of Meridional Parts. Clout's Diving Apparatus. Cost of English Battle-ships. French Budget for 1897. Foreign Navies.

DEUTSCHE HEERESZEITUNG.

Nos. 35, 36, 37. Landing of an Expeditionary Force on an Enemy's Coast. Japan's Ship-building Programme.

No. 39. Launch of the Austrian Man-of-war Budapest.

No. 42. The Improved Goubet.

MILITÄR WOCHENBLATT.

No. 38, APRIL, 1896. Effect of Wind on Flight of Projectiles. The French Cruiser d'Assas.

No. 41. Use of Torpedo-boats for Italian Revenue Service. Launch of the Iowa.

No. 50. England's Home Fleet.

ANNALEN DER HYDROGRAPHIE UND MARITIMEN METEOROLOGIE.

No. 3, 1896. Remarkable Storms. Buoying and Lighting System in Sweden (concluded). Smoothing Waves with Soap-suds.

No. 4. Influence of the Moon on Isobars. Development of Electric Lighting of French Coasts.

No. 5. Solution of Nautical-astronomical Problems by aid of Four-place Logarithms. Photographic Measurements of Coast-lines.

JOURNAL OF THE ROYAL UNITED SERVICE INSTITUTION.

APRIL, 1896. Gold Medal Prize Essay: "In view of the changes which have taken place in the composition of fleets during the present century, what system of entry, training, and distribution is best calculated to ensure an efficient body of officers and men of all branches for a peace and war establishment?" by Commander J. Honner, R. N. Essay for the Gold Medal Competition (honorably mentioned and recommended to be published by the referees); by Captain S. M. Erdley-Wilmot, R. N. The Tactics of the Future: a Review of Captain F. Hoenig's "Untersuchungen über die Taktik der Zukunft"; by Lieut.-Col. W. A. H., R. E. (continued).

MAY. The Volunteer of To-day: his Military Status, Duties and Training. Naval Essay: The Tactics of the Future. On Electric Ventilators.

JUNE. Photograph of the French First-class Battle-ship Hoche, the New Flagship of the French Channel Squadron. Meteorology: a Factor in Naval Warfare. The Necessity for an Army as well as a Navy for the Maintenance of the Empire. Abyssinia: a Brief Sketch of its Geography and History, with Map. The French 120-mm. Field Howitzer, with Plates. Short Notes on War Balloons.

REVUE DU CERCLE MILITAIRE.

MARCH 14, 1896. " Le Sociable Militaire."

This is the name given by M. Ch. Morel, the well-known manufacturer of the folding bicycle, to his last invention. The Sociable Militaire is composed of two folding bicycles braced together. It is intended, 1st, to permit fighting troops of velocipedists to move in a more compact formation, and thus get rid almost entirely of the long line of cyclers when marching with troops of other arms; 2nd, to render the passage of cyclers on roads slippery from rain or snow secure, by making a fall next to impossible; 3rd, to allow of the wounded cyclers being brought away by their comrades, and thus prevent them from falling into the hands of the enemy; 4th, in a campaign, to allow of missing or disabled cyclers being replaced by men not used to the wheel; 5th, to transport the sacks of cyclers and implements of war (dynamite, powder, tools, etc.) when on a special mission, and do away with the slow and cumbrous transportation by carriages and pack-animals; and, finally, to secure for the companies of cyclers all the independence they need.

APRIL 4. The Dervishes and the Egyptian Soudan (with a map).

It is a picture of the actual situation of affairs on the Upper Nile, which the author proposes to continue later, with a study of the operations of the expedition.

APRIL 11. The Art of Commanding: Reflections and Observations (continued).

LE YACHT.

MARCH 7, 1896.—

A paragraph in a circular recently sent to the Préfets Maritimes informs the latter that torpedo-boats actually in commission must go out to sea for practice at least twice a week.

MARCH 14. Reforms in the Central Administration of the Navy.

A novel idea is the formation of a Civil Bureau (Cabinet) in the Navy Department, parallel with the military cabinet. It would have charge of all civil affairs, the civil personnel of the Central Administration, and will also collect and centralize all matter referring to the preparation of the Navy estimates, as well as serve as an intermediary between the navy and Parliament.

Association Technique Maritime: the Battle of Yalu and its Effects upon Naval Constructions.

MARCH 21. The Composition of War Fleets.

It is an exposé of naval history during the last decade, and shows that M. Desbarres is a shrewd observer.

APRIL 4. Apropos of the Egyptian Question. The Superior School of the Navy. The Projected Naval Budget for 1897.

MAY 30. Petroleum as a Fuel. The Problem of the Fighting Ship.

REVUE MARITIME.

APRIL, 1896. At Madagascar. Nossi-Ve and the Southwest Coast Trade. The Sea-going Torpedo-boat Lansquenet. Influence of Sea Power on History (1660-1783) (continued).

MAY. A Note on the Deviations, Regulation and Compensation of Compasses. A New Telemer giving at once the Height of the Masts. An Essay on the Gyratory Effect of the Screw. Diseases of Sailors and Nautical Epidemics.

LE MONITEUR DE LA FLOTTE.

MARCH 28, 1896. The Necessary Effort.

The writer seems possessed with the idea that an imminent peril threatens France from the other side of the Channel.

APRIL 11. Phonic Signals at Sea.

APRIL 18. The Submarine Boat.

Under that title is given in several numbers the history of the progress made in France in submarine navigation.

J. L.

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*Lieutenant J. H. Glennon, U. S. N., tendered his resignation as Secretary and Treasurer on February 12, 1896. The Board of Control elected Lieut. H. G. Dresel, U. S. N., as Secretary and Treasurer, and elected Commander Edwin White, U. S. N., as a member of the Board of Control.

in view the completion of a fleet adequate to enforce the foreign policy which the nation now so vigorously proclaims, might, it is hoped, receive the support of every political party while in power.

Our permanent foreign policy may be stated as follows: first, prohibition of foreign nations from forcible acquisition of territory, or the extension of their non-republican governmental systems, on the American continents; second, the protection of American citizens the world over; third, absolute non-interference in disputes between nations on other continents. Hence it is reasonable to assume that, while we will never attempt the invasion of transoceanic territory belonging to another nation, we must be able to strike telling blows upon its nearer possessions and its commerce, if driven to war; to assist other American nations to resist foreign territorial encroachment; or to afford protection or asylum to our citizens abroad when they are threatened with injury; all the while having in reserve an additional naval force sufficient to make invasion of our own land impossible and bombardment of our home ports extremely hazardous.

Let us begin by considering the composition of a fleet necessary for our own defense. At a first glance the extent of our undefended coast line seems appalling, but we must remember that nature, in the shoals and surf of the Atlantic and the mountain walls of the Pacific coast, defends for us thousands of miles. On the west we have a mountainous breastwork, and on the east a seething moat. If we can defend the gateways and embrasures we are secure. Of these there are but three narrow ones on the west coast, but on the east there are many. Fortunately the latter can be grouped so that the same naval force may be used to defend more than one, by operating from one to another through interior waterways.

Our Atlantic coast presents almost the same strategic conditions to an enemy to-day that it did when the thirteen colonies struggled for independence, or when, in the new union, they again fought Great Britain in 1812. The waterways remain unchanged; the cities retain their same relative importance, only they have grown much richer, while their land defenses have practically crumbled away. We may, therefore, expect to be attacked at almost the same points now as then, viz. Boston, New York,

Philadelphia, Baltimore, Washington and Norfolk. In addition to these, Portland, Maine, must now be considered, because of its open harbor and railroad terminals, while the southern Atlantic ports, and especially the mouth of the Mississippi river, cannot be neglected. Portland and Boston can be considered as in the same field of defense, which I will, for convenience, call the Boston District, being the bight between Cape Cod and Mount Desert Island. The defense of New York involves the holding of all internal water routes and bays from Nantucket to The Highlands; hence I shall call this the New York District. The defense of Philadelphia, Baltimore, Washington and Norfolk is accomplished if we hold the mouths of Delaware and Chesapeake Bays, so I shall call this the Chesapeake District. Other districts will be styled the Charleston District, the Gulf District, and the Pacific District.

For the defense of the waterways leading to the cities named there is needed a class of vessels of comparatively light draught, wholly armored, yet presenting a small target, capable of steaming as fast as an enemy's fleet would dare to do in narrow or unmarked channels and shoal waters, having quick turning power, and carrying armor-piercing guns with as nearly as possible all-around fire; in short, floating fortresses which can never be passed, but which must be fought to the death before the enemy can proceed. The genius of Ericsson gave us such vessels, but we have somehow of late lost sight of their special usefulness in our coast defense. They should be double-barbette-turreted, twin-screw monitors of not more than fifteen feet draught, capable of cruising at ten knots or speeding up to fifteen, and carrying four guns of ten or twelve-inch caliber. If we should give the Boston District eight, the New York District ten, the Chesapeake District eight, the Charleston District six, the Gulf District eight, and the Pacific District ten, we would place our need at forty such vessels on the Atlantic coast and ten on the Pacific; probably a most conservative estimate. At present we have six, or about one-eighth of that number, completed; five of them being sadly deficient in speed; and in addition we have none building nor contemplated. These vessels should not be hampered with an assorted lighter battery as those in commission now are. Six six-pounder and four one-pounder rapid-fire guns should constitute their secondary battery, for it will

only be used against attacking torpedo-boats or unarmored vessels at close quarters, when the utmost simplicity and rapidity of ammunition service must be maintained. These monitors should have electric or hydraulic turret machinery, and, if hydraulic, the water should be mixed with glycerine to prevent freezing.

No torpedo-tubes should be fitted in these vessels, for their field of operations would be the same as that for torpedo-boats, and no country on earth presents such a favorable field for the use, in its own defense, of these small and destructive craft as does our own. Speeding undetected through interior waterways from Cape Cod to the Carolinas, they could be quickly concentrated in threatened harbors. They should be of the highest attainable speed, of habitable dimensions, yet of draught, length and beam which will permit them to pass through all the canals and sounds which parallel our Atlantic coast. They should have no tube fixed in the bow, but three single, center-pivot tubes, one on each side forward, with an arc of fire from right ahead to sixty degrees abaft the beam, and one near the stern amidships, with an arc of fire from forty-five degrees on either bow to right astern. Assigning ten such boats to the Boston District, twenty to the New York District, twenty to the Chesapeake District, fifteen to the Charleston District, fifteen to the Gulf District, and twenty to the Pacific District, one hundred in all, we shall still have less than any first-rate naval power, yet be able to concentrate them in formidable numbers at threatened points. At present we have three completed and six building; less than one-tenth of the needed number.

Of the eight monitors proposed for the Boston District, four should protect Portland and four Boston. The ten for the New York District could mobilize toward Narragansett Bay or Sandy Hook, according to which was threatened. The eight in the Chesapeake District should be equally divided between the two bays. The six assigned to the Charleston District should be equally divided between Charleston and Savannah. The eight assigned to the Gulf District should use Key West and Mobile Bay as their bases, and operate to hold Key West and defend Pensacola, Mobile and the Mississippi.

The double-barbette-turreted monitor and the torpedo-boat are the only vessels needed for harbor defense, but other and stronger defense must be contemplated, and in providing for this

we will be providing, too, our weapons of offense. We must have in the fleet an element which can fight the battle-ships of the enemy on the high seas. Keeping in mind that our more dangerous enemies must be transoceanic, and that our policy will compel them to send their battle-ships thousands of miles to attack us where we can fight them within easy reach of our own ports, we can dispense with some coal endurance in our line-of-battle ships and leave room to make them in other respects superior fighting machines to those of the adversary. This has fortunately been realized, and, in the Indiana and her sisters, we are building just such ships. Let us beware, however, of the craze for innovations and doubtful improvements in these vessels. Let us adopt and hold to a standardized distribution of battery, magazines, ammunition leads and auxiliary machinery, which will make one of these ships so like another that a whole ship's company could be transferred from one to another and go to quarters without changing a station.

Of these magnificent war-ships we have six building, and it seems reasonably probable that Congress will add about two a year for some years to come. If to this program other war-ships are added in the proportions which I suggest, I believe the rate will be none too fast, whereas if the monitors do not enter into the program we must treble the number of battle-ships. Providing a monitor defense as proposed would leave us still in need of a score of battle-ships on our Atlantic coast, and perhaps half a score on the Pacific.

Next, we need the armored cruiser class to fall upon the enemy's communications, to strike at his outlying possessions which might form bases of operations against us, or to send quickly to our neighbors' aid if foreign powers attempt by force to encroach upon their territory. Of such vessels we have built three, somewhat dissimilar in design, and with these the Maine and Texas would be better classed than with the battle-ships. In a fleet engagement the armored cruisers should form a second line, or line of supports, their function being, in addition to reinforcement of the fighting line, to destroy or capture crippled adversaries or to pursue and destroy the individual vessels of a routed enemy. We should have, therefore, at least as many armored cruisers as we have battle-ships; as many New Yorks as we have Indianas.

An army preparing for battle has not only a fighting line and a line of supports, but scouts to send out in advance to locate the enemy. As on land, so on the sea, scouts are absolutely essential to success in battle; and as on land scouts are picked men specially fitted for such work, so on the sea scout vessels should be specially designed for their purpose. The duty of a scout vessel would be to make long individual journeys at great speed, to gather information of the enemy's strength and movements, to refuse battle, elude pursuit and rejoin the fleet. Scout vessels need not be large, but they must be seaworthy and thoroughly habitable. They might be equipped with torpedo-tubes, and they should have rapid-fire guns, but they should be otherwise unarmed and need carry only machinery protection. They should be modeled so closely after ocean coastwise passenger steamers as to be readily mistaken for them. Above all, they should have enormous speed and great coal endurance. I believe that such vessels could be built with a cruising speed of twenty-five knots per hour, and a maximum forced-draught speed of thirty knots. Keeping in mind their special purpose, much could be sacrificed to this end, even the protection and some of the armament already stated. Such vessels must be built expressly for their purpose. The fact that no country is attempting such a type is the best reason why we should lead the way, for the country best equipped with scout vessels will place an adversary at a great disadvantage in time of war. The torpedo cruiser somewhat approaches the type, but is lacking in seaworthiness, habitability and coal endurance, besides being unmistakable in her character when sighted. Ten or more scout vessels would be a valuable addition to our fleet.

The roving commerce destroyer is still another type needed for war. Such modern "Alabamas" will have many of the qualities of the scout class and might be used as scouts in the absence of specially designed scout vessels. Their speed should be twenty-two knots; their coal endurance enormous; their appearance that of an ocean liner, with straight stem, pole masts, no military tops, and smoke-stacks of a conventional number and size. Their armament should be five-inch or six-inch rapid-fire guns. The United States has come nearest of any nation to building such vessels in the Columbia and Minneapolis, but they have the ear-marks, so to speak, of men-of-war, and would not deceive a moment after their hulls appeared above the horizon.

These vessels could be drawn from the merchant navy *if we had one.* We are taking some steps toward getting them from that source, and now have four available, ***but not a gun to put on board of them!*** We need at least ten such vessels on each coast.

There remains to be considered the type of vessel best suited to represent us in time of peace on foreign stations, and to be prepared to give protection and asylum to our citizens residing abroad. We have built many war-ships for this purpose, calling them second class protected cruisers and gunboats, and have a great variety of types from which to select a standard. The cruisers should be roomy and comfortable; should have main batteries of six-inch rapid-fire guns; should have twin screws and fore and aft sail; should be composite built and sheathed, and should have a cruising speed of twelve knots and a maximum speed of twenty knots. The Chicago, when renovated, although not composite, would be, if sheathed, an ideal cruiser of this type. The gunboats should be specially designed, in dimensions involving draught, for the stations on which they are to serve. They, too, should be composite and sheathed, with twin screws and a cruising speed of ten knots, or maximum of fifteen, and should be barkentine rigged, with all the coal endurance possible, plenty of living space, and an armament of four-inch, six-pounder and one-pounder rapid-fire guns. We have, however, second class cruisers and gunboats enough built and building for our present needs.

Rams, dynamite-gun vessels, submarine torpedo-boats and such experimental craft cannot be considered in the composition of the fleet until their usefulness is proven, but we have not yet reached the limit of human invention and should be prepared to add a new element whenever it is fully developed.

To sum up, it is assumed that the fleet for all purposes should be composed of the following elements:

No.	Character.	Type.	Provided.
30	Battle-ships.	Indiana.	6
50	Double-barbette-turreted Monitors.	Monterey.	6
30	Armored Cruisers.	New York.	5
20	Commerce Destroyers.	Columbia. St. Paul.	6
10	Scout Vessels.	....	0
20	Protected Cruisers and Gunboats.	Renovated Chicago. Gunboats Nos. 14 & 15.	25
100	Torpedo Boats.	Cushing Improved.	9

On this basis we should, therefore, build, as rapidly as possible, twenty-four more battle-ships, forty-four more double-barbette-turreted monitors, twenty-five more armored cruisers, ninety-one more torpedo-boats, ten scout vessels; and should also build, or encourage by subsidies to be built as American ocean liners and auxiliary cruisers, fourteen more commerce destroyers, at the very least. Suppose that, with this end in view, we adopted the following yearly building program:

2 Battle-ships	$8,000,000
3 Monitors	4,500,000
2 Armored Cruisers	5,000,000
1 Scout Vessel	800,000
12 Torpedo-boats	1,200,000
Total	$19,500,000

Allowing for a subsidy for the commerce-destroyer class, we would thus, by an investment of $20,000,000 a year, produce in ten to fifteen years such a formidable fleet that every principle of our foreign policy could be vigorously and assuredly maintained.

One of the most important points to be kept in mind in this building program is the necessity for similarity in designs. A new Kearsarge should be so similar to an Indiana, a New York to a Brooklyn, a Monterey to a Terror, sister ship to sister ship in each class. that the watch, quarter and station bill of one battle-ship or monitor or cruiser could be substituted for that of another, so that the man who pulled a lever, opened a valve, turned a crank, connected a primer or transported a shell in the one ship would find at hand the same apparatus in practically the same place in the other, for all these vessels could not be kept in commission at once in time of peace. A large number of them would have to be laid up in charge of a small force of ship-keepers, and the individual vessels commissioned in rotation by a wholesale transfer of officers and men from the vessels to be laid up in their places, and then manœuvred to see that each was maintaining its fighting qualities. Those lying "in ordinary" would prove excellent schools for our naval militia.

The life of a steel ship properly cared for has really never

been ascertained. Half a century is perhaps a low limit. Moreover, while theorists will suggest a hundred radical changes in each ship of a class designed, the real improvements are simple and infrequent, and it is probable that the war-ship of to-day will be able to carry the latest weapons and fight with even chances a new-born adversary of her class thirty to fifty years hence. We must not let the unfounded fear of obsoleteness deter us from standardizing our designs.

Investing twenty million dollars a year for the next ten or fifteen years in such a fleet as is suggested would be paying a very low premium for a vast national insurance. At the end of that time further investment to maintain the fleet would be in much smaller yearly sums, and we would have practically a paid-up policy.

Reviewing this suggested composition of the fleet, the item which, I fear, will be most quickly challenged is that of monitors, because of the large number suggested, compared with the number of battle-ships. It is not that I place more reliance in monitors than in battle-ships, but that the former must be so differently disposed. The monitors must be distributed; the battle-ships can be mobilized. The latter correspond to the army in the field; the former to the garrisons of fortified places. If the enemy succeeds in defeating or eluding the mobilized battle-ships, he must find the monitors in force at any port which he may choose to attack. Some mobilization of the monitors in a district may become possible when the point of attack is disclosed by the movements of the enemy, but our geographical contour prevents the districts from being within supporting distance of each other; so I do not see how we can dispense with this class of vessel, nor how a smaller number than that proposed will suffice. Moreover, we can complete nearly three monitors for the money spent on one battle-ship, and a monitor requires about half the time to build. We must remember, too, that even our chief seaports are in no degree protected by land fortifications, and that it seems unlikely that they will be for many years to come. Farragut has shown us, moreover, that even unarmored vessels can ignore fortifications and proceed past them to the very city which they are striving impotently to protect. Even, therefore, if every city in the districts which I have mapped out were heavily fortified, I should not reduce the number of monitors assigned for their defense.

I would regard the number of special scout vessels suggested too small were it not that the commerce-destroyers can do efficient scout duty, sometimes even while engaged in their intended occupation. Torpedo-boat destroyers, or torpedo cruisers, as they are variously called, are too limited in their usefulness to warrant them a place in the fleet, but if scout vessels were built in large numbers they would, since they possess all the functions of these less useful vessels, be available in place of them when so needed.

I do not think that the number of torpedo-boats proposed can be criticised unless to say that it is too small.

To the Pacific Coast I have assigned ten monitors; four to operate in Puget Sound, four in defense of San Francisco, and two to defend San Diego, with twenty torpedo-boats to be distributed in similar proportions. These, behind a mobile squadron of ten battle-ships and ten armored cruisers, with ten commerce-destroyers for scout duty and to harass routes of communication, should form an ample defense. Russia, Japan and Great Britain are the only nations which could strike a blow at us on the Pacific, and none of these could maintain a hostile fleet on that coast for any length of time if we had any force at all to throw upon their communications. England might for a time supply a Pacific squadron through Canada, but that would be the easiest link for us to break. England, however, would concentrate her efforts upon our Atlantic ports, operating from her strong near bases, and waste very little attention upon the Pacific side of the continent.

In this attempt to suggest the proper composition of the fleet I invite discussion more upon the elements proposed than upon the number of vessels in each class. Of the latter I will only add that I have endeavored to suggest a program which will not exceed twenty million dollars in yearly outlay, which will not overtax the capacity of our shipbuilding establishments, yet which will produce in fifteen years at most an adequate fleet. Considering that we have had literally to recreate a navy, we have advanced thus far with admirable discretion. We first had to build the cruisers and gunboats because the shipbuilders were then incapable of building anything more complex; the wooden navy was expended and had to be immediately replaced; appropriations were difficult to obtain, and the people had to be shown

something for their money as quickly as possible in order that they would continue to give it. We have educated the ship-builders step by step until they can now build anything from the swiftest torpedo-boat to the finest battle-ship afloat, and now is the time to profit by this readiness and this education which we have so carefully fostered. We have already finished one war vessel or more of nearly every type, and they can be used as object-lessons with which to educate the people as to their purposes and their necessity. We have, in fact, just reached a very critical period in our war-ship building. We must not now drift along in a desultory fashion, timidly watching the inclination of Congress and asking only for whatever ships it is disposed to give us, until the building impulse dies. We must earnestly and vigorously urge a systematic, progressive program, having as its outcome the production of an adequate fleet in the fewest possible number of years, explaining incessantly the need for each type of vessel, and illustrating the usefulness of all by constant organized manœuvres on our coasts and in their adjacent seas.

Since this essay I have been fortunate enough to attend the summer course at the Naval War College, where a more thorough study of the strategic and tactical situations produced by the conformation of our coasts and the location and character of our harbors, together with many side lights thrown upon the subject by able lecturers, has somewhat modified my views as to the relative number needed of battle-ships and barbette monitors.

The monitors find their special sphere of tactical usefulness in broad, land-locked waters traversed by comparatively narrow, deeper channels leading to important points. Here these powerful, light-draught vessels can choose positions of such tactical advantage in the shoaler waters, that the enemy's battle-ships, constrained to follow the deep channels, would suffer immeasurably more than if confronted only by vessels of their own kind limited to the same channels as themselves. Our Atlantic coast is remarkably penetrated by just such bodies of water: Nantucket, Vineyard, and Long Island sounds; New York, Delaware and Chesapeake bays.

On the other hand I am convinced that the monitor is of no advantage in uniformly deep harbors like Penobscot Bay, Portsmouth harbor, the Mississippi River and San Francisco Bay,

and that this type is practically useless in harbors into which the enemy's battle-ships cannot penetrate, such as Boston, Portland and Charleston.

The gulf ports of Tampa, Pensacola and Mobile can be so readily deepened to battle-ship draught, and this is so likely to be done, that I still think it would be well to build monitors for their defense, as suggested in the essay.

Consequently I now regard the monitors suggested for the Boston and Charleston districts, as well as those proposed for San Francisco Bay, unsuited for the defense of those districts. In place of these twenty monitors, six battle-ships should be built and added to the Atlantic fleet. The yearly programme would then be two battle-ships, two monitors, etc., with an additional battle-ship every other year until the desired number were completed.

It has been suggested to me that advocating the barbette-monitor type is impolitic, because Congress will too readily abandon the battle-ship in favor of the cheaper vessel, but I only wish to see the monitor receive its proper relative attention in a systematic and comprehensive building programme. Whenever Congress, by falling short of the programme, compels us to choose one type and abandon another, let us insist, with the utmost intensity, upon battle-ships.

JOHN M. ELLICOTT, *Lieut., U. S. N.*

DISCUSSION.

Lieutenant-Commander RICHARD WAINWRIGHT, U. S. Navy.—There is no more important subject to the Navy than the one treated by Lieutenant Ellicott in this paper. The various types of vessels to enter into the composition of the fleet are more likely to be affected by the opinions of the naval officers, and therefore to be influenced by discussions in the Proceedings of the Naval Institute, than the number of vessels to be built for the Navy, which will be determined by economic considerations and the opinions of our legislators for the time being. Still, in the question of numbers, the public may be guided to some extent by the opinions of naval officers, as long as the opinions are conservative and appear to be based upon the present needs of the country, and not upon speculative views of future requirements or upon mere ambition for the acquirement of a large naval force.

Our first and principal need of a naval force is for the defense of the coast, which includes the lines of communications to and from the ports of our coast. Until this requirement is filled it is futile to consider anything further. In forming a scheme for coast defense a mobile navy and army and the immobile defenses pertaining to the army should all be considered together in order to design the strongest defense for the smallest expenditure of money, for in such schemes economical considerations control.

In the question of guns our naval vessels come in contact with the immobile defenses of the army and in the question of landing forces with the mobile force. It costs far more to mount and protect guns afloat than ashore, but the effective radius of the gun on shore is limited by its range, while that of the gun afloat is limited only by the coal endurance of the ship. Again, carrying troops on men-of-war is far more expensive than carrying them on transports, yet where a small force only is needed a landing party from a ship-of-war may be very effective. The scheme should be so designed as to utilize the best points of the mobile and the immobile defenses, and refrain from mixing their qualities. What can be best done on land assign to the army; what requires to be confined to one port or district assign to the fixed defenses, and leave to the naval forces their principal merit, mobility. Cases may arise where, because of certain topographical peculiarities, a harbor requires floating batteries for its defense; but they are fortunately few. Even torpedo boats, which are an inexpensive means of securing a certain amount of defensive power, when supported by a naval force and protected by fixed defenses or difficulties of navigation, should not be confined to the limits of particular ports.

The most expensive way of mounting guns, when due weight is given to their proportional effectiveness, is on monitors or floating batteries. The cost is far greater than mounting them on land, and the effective radius is but slightly increased, while accuracy of fire is decreased. I therefore strongly dissent from the writer's proposition to build fifty

monitors, and firmly believe that we have sufficient of that type to meet our present needs, if we are to have adequate fixed defenses.

Commerce destroyers have but little military value and I should regret to see the nation's wealth diverted to such costly experiments; and while all naval officers must gladly welcome the addition of many St. Pauls to our merchant marine, it is to be hoped that a better employment than commerce destroying can be found for them in time of war.

Lieutenant Ellicott has confused the army scout with the spy, and in the same way has confused the functions of the vessels he compares with the army scouts. A fast vessel of great coal endurance with but little power of offense or defense, and resembling a merchant vessel, would partake more of the characteristics of a spy than a scout, and similar limitations must be placed upon the nature of the information that can be obtained by them. The vessels he proposes to build would be costly experiments while we have a suitable merchant marine to draw upon for the purpose. The true scout is the armored cruiser of from 6,000 to 7,000 tons displacement. I do not think Lieutenant Ellicott has grasped the true use of the armored cruiser, and I do not believe it is advisable to create more New Yorks. Our protected cruisers have sufficient offensive power for scouts, but are wanting in protection. We want a vessel that can take considerable punishment and endure a little fighting when endeavoring to obtain information. If two fleets were endeavoring to gain touch with each other with protected cruisers for scouts, either the scouts would destroy each other, or the only information that would be brought back by the runaways would be that the enemy's scouts were out. To bring news of the strength of the fleet we require the endurance of armored cruisers, and the necessary qualities have been obtained in other countries by building vessels of less than 7,000 tons.

The only objection I see to Lieutenant Ellicott's requirements as to torpedo boats is the difficulty of obtaining boats "of the highest attainable speed, of habitable dimensions, yet of draught, length and beam which will permit them to pass through all canals and sounds which parallel our Atlantic coast." I should have thought that it would have been necessary to improve a few of the canals and some of the channels in the sounds or else to be satisfied with inferior boats.

The most dangerous portion of Lieutenant Ellicott's paper, to my mind, is that which sets forth the formidable fleet that he believes should be produced in the next ten or fifteen years. His heresies as to types may not have very serious weight with those who have the shaping of our naval shipbuilding policy; but even now a portion of the public view the Navy with suspicion and suggest ambitious motives, when only an inadequate defense has been suggested. To give them cause for such suspicion, as Lieutenant Ellicott's paper does, is to jeopardize the future of the Navy and tends to prevent our having a naval force adequate for the defense of the coast and sufficient to maintain the integrity of our communications. I trust that many officers will register their disapproval of this ambitious program, for I know that there are but few who do not think it calls for a fleet far in excess of the present needs of our country.

We need more battle-ships, more armored cruisers and many torpedo boats, with some fixed defenses, both fortifications and mines. But to build Chinese walls on land or European armadas for the sea is not in accordance with the policy of this country, nor can it be for the good of any republic.

Lieutenant J. C. WILSON, U. S. Navy.—The subject which the writer has chosen for discussion is one not only of interest and importance to the naval service and country in general, but it is a subject which cannot be discussed and settled too soon; as upon "the composition of the fleet" depends our ability to protect our shores from invasion, our seaboard cities from devastation, as well as to enable us to deal damaging blows to the enemy:—in short, to make a successful defense of our property and honor, and to maintain that position of power and influence, as well as to assume the responsibilities which belong to the greatest nation of the Western hemisphere. Strategy and tactics, knowledge of our own waters and of methods of offense and defense, are of but little avail without the "Fleet"; and the "Fleet" is valuable in proportion to its properly constituted and balanced strength. Such proper constitution of naval forces cannot be obtained haphazard. It must be arrived at by systematic study by the best experts, and a regular program laid down by which in a reasonable time we shall possess a fleet commensurate with the requirements. Such a program should be accepted by Congress and an "Act" passed that the "Fleet" should be increased by so many tons per year, leaving to experts the details as to how this tonnage should be divided. I agree with the writer in the desirability of having a number of comparatively light-draught monitors for coast and harbor defense, but I think they should be capable of maintaining a speed of twelve knots, for reasons hereafter referred to. I do not agree with the writer as to the distribution of these monitors. Counting out the Pacific coast and accepting as sufficient thirty monitors for the Atlantic coast, I think the separating of these thirty into five divisions, most of them out of radius of mutual support, introduces an element of unnecessary weakness. If six monitors are good, twelve or more are better, and it will be conceded that if the twelve or more can be brought against the enemy together they will do more good than if half of their number were sealed up in harbor or inland waters. I think the monitors in question should not be divided into more than three divisions, the larger one (say of twelve) to rendezvous in the torpedo protected waters of the Vineyard Sound; another (say of ten) in those of the Chesapeake, so as to be within supporting distance of the main fleet of battle-ships, which would take the sea to meet an enemy approaching our coast. The third (say of eight) I would rendezvous in the Gulf, preferably at Mobile. The sea-going torpedo boats should be distributed with the monitors. Should an enemy succeed in eluding our fleet, the harbor defense of torpedoes and fortifications should be sufficient to hold them in check until our available floating force of battle-ships, monitors and all, could be brought against them.

This point, however, is more a matter of detail than of the question of "the composition of the fleet." While agreeing with the writer as to the desirability of monitors, I do not agree with him as to the immediate necessity as compared to battle-ships and torpedo boats. In the program for yearly building I should build at least six battle-ships and twenty torpedo boats. I advocate, however, increasing the yearly expenditure to $30,000,000, so as to include the monitors, armored cruisers and scout vessels. I do not think it wise to construct more than six vessels of any one class (other than torpedo boats) per year, owing to the changes in details of construction and varying conditions of warfare which are developed from time to time. If $20,000,000 were all that could be expended in any one year I would devote the whole amount to battle-ships and torpedo boats.

I think the idea of having specially constructed scout vessels a very good one, though should our merchant marine ever become rehabilitated it might be depended upon for these vessels. The advantage, however, of having them specially constructed and always available as part of the fleet both for manœuvres and war service, is I think sufficient to warrant their special construction.

I do not agree with the writer as to the importance of similarity in design in vessels. It is a very easy matter to modify a "watch, quarter and station bill" so as to apply to any vessel, and whether the levers, valves and cranks are in the same position in all vessels or not is in my opinion a matter of no great importance, as the men whose duty it becomes to handle them can readily learn their positions and peculiarities of construction. It is very important, however, to have a "homogeneous fleet," that is, a fleet composed of vessels of equal or nearly equal speed, coal endurance and manœuvring qualities. All the vessels of a fleet should be at least up to a standard speed and coal endurance, and the units of each class as nearly equal in offensive and defensive qualities as practicable. In this connection the cruising speed of a "fleet" should be determined upon, and vessels built with this point in view. Of course, vessels intended for special work could be designed accordingly, but all should be equal to maintaining the "fleet" requirements. For this reason I advocate (as already mentioned) the monitors being able to maintain a speed of twelve knots so that they could act with the "fleet" whenever considered desirable. Taking into consideration the "armor and armament" and coal endurance considered necessary for a first-class battle-ship, moderate speed only can be obtained, and fifteen knots are considered by the best experts as the maximum speed necessary for a battleship under natural draught. This means a maintained speed of about twelve knots, and is accepted as the "fleet" speed of modern war vessels.

It is to be hoped that at no distant day we will be able to have "manœuvres" similar to those inaugurated by the English, where the attacking and defending fleets would be complete as to composition and manœuvred as in actual warfare. All drills, tactical exercises and strategical problems necessarily lead up to the point of giving practical illustrations of the part that our "fleet" is to play in case of war. The "War College" is

doing invaluable and necessary work in expounding methods; but practice with the "fleet" under probable conditions of war is absolutely necessary before we can know what can be done with it; and in order to get the best, or even satisfactory results, "the composition of the fleet" must be carefully studied and the results of such study systematically carried out. I think, in this connection, it is well to call attention to the necessity of the same care being taken respecting the "personnel"—and I can think of no better way to insure the necessary and systematic increase of this force than by authorizing a per-tonnage increase. I am not prepared to say how much the personnel should increase to keep up with the "matériel," but I think it would be safe to say about five hundred per ten thousand tons. The writer has chosen a most important subject for discussion and has handled it in a most admirable manner, and I feel sure that the exposition of his views on the subject cannot but be productive of goods results.

Commander C. F. Goodrich.—I have never read a paper in the Proceedings of the Naval Institute which, in my opinion, exhibited no single redeeming feature, but the essay by Lieutenant Ellicott very nearly satisfies this exacting condition. Broadly speaking, he proposes nothing which commends itself to my judgment. The enviable ease and grace of his diction appear alone to have warranted the award of an honorable mention.

There is no evidence that "we are in daily jeopardy of national humiliation by seeing some strong power deliberately ignore our doctrine," etc. Yet upon this assumption he bases his demand for a colossal fleet. If he be correct, then the wonder arises as to how we have managed to escape a direful fate during the twenty-five to thirty years following the late war, when our navy was a négligeable quantity,

Mr. Ellicott's plan rests upon a policy which he thinks the nation should adopt, but he fails to show any good reason for so radical a departure from the teachings of Washington that have gradually crystallized into the unwritten law of our dealings with foreign powers. Our predominance in the Western world derives from a consistent and honorable course of upright action towards others and from a recognition of our great contingent power. It loses no strength from our immediate lack of an overwhelming fleet. Some measure of available force is desirable, lest our interference be deemed capricious and our rights be ignored; but, surely, under no conceivable circumstances compatible with just regard for others can we ever have need of so stupenduous a defense as is suggested. I am almost led to suspect that a joke has been perpetrated on those who take the essay seriously. Except for the fear that outsiders might be induced into misapprehending the general opinion of the Navy, I should spare my time and your patience in this discussion.

Mr. Ellicott is right in calling for a yearly increase of vessels "as large as the finances of the country will permit." We still need more ships of proper types, but things are come to a grievous pass if it is necessary to spend three hundred millions of dollars before we can be reasonably

secure from molestation! As well write three thousand millions—one sum is quite as easy to secure as the other.

The fact is that the writer's premises are all wrong. He has unconsciously adopted the army notion of coast defense, and a great part of the fleet he proposes would be a mere adjunct to the fixed works. Now, the army has literally and absolutely nothing to do with *coast* defense. Its province is *harbor* defense pure and simple. It is time this distinction was drawn, before the unfortunate and unwarranted deduction is made that the defense of our seaboard can be effected by soldiers. History in general—our own in particular—teaches that attacks from over the water are repelled by ships. Yet we see military writers in high authority lamenting the money already spent on the Navy, and arguing that the same sum would have accomplished the complete protection of our *coast*. Towards such a mistaken notion this essay, if unchallenged, will be a positive and doubtless welcome contribution. The country needs fortifications—neither extravagant nor unduly developed—at the principal ports, for refuge, for bases, and against bombardment. More than this it does not want. The fleet can and will do the rest.

We want *no* coast defense vessels of *any* particular type, for, as Captain Eardly-Wilmot, R. N., has justly remarked, "The principle of building special ships for operations confined to the coast found no favor with our ancestors, taught by the experience of long wars that a sea-going fleet is the best defense against any attempt on the part of an enemy to approach our shores. . . . It has been well said, also, that all ironclads are coast defense vessels, when coasts require to be defended; but when coasts do not require to be defended, a ship which can defend coasts and do nothing else is a ship out of place." What we *do* want is a few, a very few, more battle-ships and some torpedo boats. When we get these we shall be in a position to laugh at any enemy, no matter how strong his fleet may be at home. To attempt operations on our seaboard—our squadron of eight or more good battle-ships being in hand—is a task not lightly to be undertaken by any foe. Personally I incline to the belief that it would never be attempted, for time and locality are on the side of the defense.

To localize our naval defense as is proposed would be to scatter our forces, abandon strategy, surrender the command of our water approaches, and forget the teachings of the past. For one I record an emphatic protest. If Mr. Ellicott gets all the battle-ships his program calls for, his harbor defense ships will be needless. If he can't get his battle-ships, then his monitors will be misused. There is no *tertium quid*.

Mr. Ellicott further wishes as many armored cruisers as battle-ships. Now, while the armored cruiser *may* be a valuable unit, the fact has not yet been shown. She is a new type without analogue in the past. It would be unwise to build more vessels of this class until their true use has been demonstrated on sound tactical grounds. I only mean to imply that we have all taken her for granted and that, as yet, no one has made out a good case for her. We should postpone building armored cruisers until our fighting line is made up. Even then, few admirals, if given the

choice, would prefer an armored cruiser to an additional battle-ship. When the Navy has money to burn it will be time enough to call for new and untried types.

Mr. Ellicott has a mistaken notion as to the scout. She *should* be large, for with increased size comes increased steaming radius and the ability to proceed in heavy weather. She should *not* have torpedoes, for her duty is to observe and report—not to fight. Her safety lies in her speed.

I am surprised to find at this day, and among naval officers, an advocate of commerce destroying. Wars are brought to a conclusion by defeating fleets and armies—not by letters of marque afloat and guerillas ashore. We won our independence, not by privateering, but in spite of it. Although we had at one time hard on to 90,000 men in armed vessels, we had to turn to France and her organized marine for the substantial aid that ended the war.

The War of 1812 was a drawn game. Both sides tired of the quarrel and agreed to stop. The treaty of peace contains no mention of the grievance that led us to throw down the gauntlet. Surely our wholesale adoption of this predatory warfare, had it been of real military value, ought to have gained us something on the credit side when the accounts came to be settled.

It is well known that commerce destroying had no influence on the result of the Rebellion, vast as was our loss. And yet, at this late date we find a thoughtful naval writer asking for more Columbias! It seems incredible.

I am sorry to differ so radically with a colleague of such capacity and intelligence, but believing, as I do, that the views he advances are certain to work great harm to the service, both inside and outside, I have not hesitated to speak strongly in opposition. We cannot afford to be thought by the country at large as favoring such draughts on the treasury for a shipbuilding policy which in many of its parts is absolutely condemned by many competent authorities and the necessity of whose extent is not proved beyond peradventure by historical precedent.

Lieutenant R. C. Smith, U. S. Navy.—I have read Mr. Ellicott's paper with interest, and I doubt if much fault can be found with the main propositions he advances. His essay is almost too brief in view of the importance of the subject, and its different features could well be dilated on.

Perhaps an amplification of the proposed torpedo flotilla might be considered. The last three or four years have witnessed a very extensive modification of opinions which had prevailed for a considerable period and were evidenced by certain lines of construction.

Thus there were torpedo boats pure and simple, of the first and second classes; the former more or less independent and some actually seakeeping, the latter designed to be carried on the decks of vessels. There were the torpedo boat catchers of 400 tons and upwards, which could catch torpedo boats in rough weather but not in smooth, and could not follow them into shoal water. They had a fair torpedo armament to use against

ships when they had a chance, as well as the rapid-fire gun armament to use against torpedo boats, *vide* the English Rattlesnake.

Then there were the torpedo cruisers, the use of which has never been demonstrated. They were too slow to catch torpedo boats, too slow for scouts, too weak to go near enough to larger ships to use their torpedoes when they could be seen, and too large to get near enough without being seen. They had usually a heavy gun armament and a large torpedo armament. The English Scout, from which our Yorktown class was developed, was a fair example.

The first-class boats were found to be unsatisfactory except when used from a fixed base. The crews could not live in them for extended periods at sea in all weathers. Their scope was found to be in operating with the squadron on its own coast and in raiding from a base.

The second-class boats are not in great favor because they cannot be used from ships except in fair weather, and if they are not lowered in action they will be shot to pieces in their cradles. The compromise is a vidette launch, now often of wood, under 60 feet in length, steaming 16 or 17 knots, armed with a light gun, carrying her torpedoes inside frames or leaving them aboard ship, as the case may be, and taking her chances in an action with the other boats of the fleet.

The torpedo boat catchers are absolutely discredited. In the struggle to make them seaworthy and habitable the size was increased to 1,100 tons, as in the English Dryad class, in which the speed did not exceed 19 knots.

The torpedo cruisers were habitable, but had even less speed. The modern idea is to omit torpedoes in all the above types except torpedo boats proper, and to modify their batteries by substituting the greatest number of the lightest rapid-fire guns consistent with displacement. None others will probably be built except in the scout class proper.

From the above considerations sprang the torpedo boat destroyers. These vessels were to be fast enough to catch torpedo boats in rough or smooth weather, and were to have light enough draught to follow them into shoal water. They were to be large enough to be seaworthy and habitable, but not large enough to sacrifice invisibility under conditions suitable for torpedo attack, and were to have a good steaming radius. Their armament was to be primarily guns, but they were to have a few large torpedoes to use against ships. The requirements pointed to an enlarged torpedo boat, The result is the class from the Havock to the Desperate, from 220 to 300 tons, and from 27 to 30 knots.

As to our own needs, there seems to be little use in going beyond the Cushing until the destroyer class is reached. The Cushing of 138 feet and 106 tons, is large enough and has speed enough to operate from a shore base. This could well be the type for permanent harbor defense and for the use of the Naval Militia.

To accompany the fleet a boat of double the size is required, from 250 to 300 tons. It is difficult to find a use for intermediate sizes. They can be made faster than Cushings, but they are larger than necessary for their armament and the duties required of them, and are not large enough to keep the sea permanently.

Speed is useful in arriving on the scene of action and in getting out of action. In a surprise attack at night a moderate rather than a high speed is required both to prevent discovery by the bow wave and to enable the torpedoes to be launched with accuracy. Speed, however, is useful in catching torpedo boats. These considerations practically determine two types, torpedo boats proper and torpedo boat destroyers.

The short torpedoes are practically given up abroad for want of accuracy. The prevailing type for all boats except vidette launches is the long 18-inch (5 metres, 16½ feet). The tubes are preferably on the centre line, and are two or three in number according to the size of the boat. The long spoons permit a very fair angle of train on either beam. Bow tubes are abandoned, for structural and weatherly considerations, on account of the danger of overrunning the torpedo and because they cannot be used in a seaway. Short torpedoes may be mounted on the sides, as are the Cushing's, but for the longer type the practice would be preferably as above. For vidette launches the long 14-inch torpedo is preferred to the short 18-inch.

I should therefore increase Mr. Ellicott's allowance of 100 first-class boats, which he very properly stations in the ports of the various districts, by 50 torpedo boat destroyers to accompany the fleet wherever required. It is to be noticed, however, that these destroyers should be able to navigate all the canals and inland waters along the Atlantic coast. For this purpose they should not exceed 210 feet and 300 tons. Only special and local considerations will in some cases justify types different from the two indicated above.

Commander C. C. Todd, U. S. Navy.—Lieutenant Ellicott's article gives every evidence of much careful thought, but I must differ on one or more points, while agreeing in the main.

I assume our fleet is to be primarily a defensive one. Our future operations will be on this side of the western ocean, therefore the work devolving upon our Navy can be done by a smaller one than that called for by the essayist. The best harbor defense is the best coast defense by means of a force that will drive from our shores any sent across the water against us. As the monitor type is not an efficient sea-going fighting vessel, I would build no more of that class.

We now have, or are building, enough of the so-called cruiser type. Their use in war would be but incidental, their places and functions of scouts being replaced by auxiliary merchant steamers of equal or greater speed and very much greater steaming radius. This also applies to the Columbia class, as provided for by Lieutenant Ellicott.

I fully agree with the writer as to the necessity and value of the *armored cruiser*. In my own mind, they are only inferior to the battle-ship itself. I agree that one of this type should be provided for each battle-ship, but would not choose the New York as a type. I would prefer an enlarged Olympia of not exceeding 7000 tons, which would give her a light armor belt to keep out light projectiles.

Modern conditions call for the presence in a battle fleet of a propor-

tion of torpedo-boat destroyers and torpedo-boats. The proportion of the former I would fix at one for each battle-ship, of about 800 tons displacement; of the latter, *two* (of about 150 tons displacement) for each battle-ship.

As to the battle fleet itself, we must in emergencies expect to have a percentage under repair, such that they cannot be brought quickly into service. But, in my judgment, for purely defensive purposes we could well fix the maximum at *twenty;* sixteen for the Eastern, four for the Western seaboard. But in fixing this number I would be understood as including only the later battle-ships, not the Maine or Texas.

For coast defense the fleet suggested would be—

Battle-ships, 1st class, Indiana	20
Armored cruisers, improved Olympia	20
Torpedo-destroyers (800 tons)	20
Torpedo-boats (150 tons)	40
Auxiliary cruisers for scouting	40

This does not of course apply to harbor defense by *smaller* torpedo-boats, etc., but with such a fleet efficiently handled we would have the best *coast, harbor,* and *national* defense from foreign assault.

Lieutenant W. F. FULLAM, U. S. Navy.—Mr. Ellicott's essay is a model of brevity and logic. The practical principles that should govern the building of our Navy are presented so clearly and concisely that those who have not the inclination or patience to read the volumes that have been written on the subject may get, in these few pages, all the information that is really necessary. There are many such people. For the good of the Navy they should have a chance to read this essay.

The building programme advocated is not an extravagant one for a country as large as ours with such an extensive coast. We have suffered greatly from the theory, heretofore advanced so generally, that this country only needs a *small navy,* and that the chances of war will be lessened by remaining in a defenseless condition. Considering the inevitable growth of the United States in population and wealth, and the expansion of trade that is sure to follow, the one hundred and sixty ships of all classes and one hundred torpedo-boats proposed by Mr. Ellicott will not constitute a large navy by any means. Those who believe that a navy is a necessity should stop treating the subject in a timid and apologetic tone. Instead of begging Congress for appropriations they should point out to the taxpayer in plain English just what this country must have to maintain its position and dignity as a nation.

Mr. Ellicott has selected the proper types of ships—there can be no doubt of that—and it is gratifying to find the proportion of fighting or battle-ships so large in his building programme. Our Navy should, above all things, be built to fight.

In dividing the coast into districts and in taking account of strategic conditions and requirements the essayist has built his argument upon a rock. It is in this manner that the Naval War College—thanks to its

influence—approaches this question. An intelligent "General Staff" would handle it in the same way. Every country should build its navy to suit such conditions.

There is, perhaps, one legitimate cause to criticise some of our new ships, due to the failure to suit the design to the peculiarities of our coast. Some of our ships draw too much water. It would be a great point of advantage in time of war if the draught of our ships could be kept down to the lowest practicable limit, so that they might safely enter certain channels and ports in all conditions of the tide. The latter condition might keep the enemy out and hamper his movements. At present we lose this advantage in some cases. Ships are compelled to wait two weeks for a high tide to get into dock, and two weeks more before they can get out. In the meantime they might be sadly needed.

In advocating the standardizing of ships and their machinery and fittings, and uniformity in organization also, the essayist sounds one of the key-notes of readiness and efficiency for war. When we note the lack of precision in the evolution of a squadron made up of different types of ships with different turning circles, etc., the advantage of having one type in each line is at once apparent. It would bring order out of chaos very often. And if machinery and fittings are standardized in each type, fatal delays may be avoided. One ship may furnish another with spare parts in an emergency. The Indiana was once saved a long delay by getting a valve stem from the Massachusetts. The result of a battle might hinge upon such an incident.

It is time to come to a definite decision regarding certain matters in naval construction and in ship organization. The data at hand is sufficient. Pigeon-holes are well stocked with valuable information. Some of it should be taken out and used.

Lieutenant J. M. Bowyer, U. S. Navy.—I have read with great satisfaction the valuable paper on "The Composition of the Fleet," by Lieutenant John M. Ellicott, U. S. Navy, and am pleased to note that his subject has been carefully and well considered and ably handled.

It is nine years since I had the pleasure of taking the course at the Naval War College, but I think I recognize the ear-marks of that excellent institution in Mr. Ellicott's essay, not only in the soundness of his propositions, but also in the total absence of what may be called "snap-shots."

There was a time, not many years ago, when almost every officer of the Navy, regardless of rank or corps, was not only ready at all times, but willing and apparently anxious to take a "snap-shot" at the needs of the country as regards the Navy. Everybody had an opinion ready at hand, or would manufacture one on short notice and without sufficient deliberation.

The War College has taught us that the composition of the fleet is a problem which demands careful study and an intimate knowledge of all its factors.

I agree perfectly with the essayist in the following statement, which

might well be adopted as the Navy platform: "To uphold that [the Monroe] doctrine against all odds we must have a powerful fleet, and until we build it we are in daily jeopardy of national humiliation by seeing some strong foreign power deliberately ignore our doctrine, while we hold ourselves up to ridicule by impotent protest, or sacrifice our small nucleus of a Navy in a futile attempt at enforcement." Recent events emphasize every word of the foregoing, and our legislators must be made to fully understand that we cannot do something with nothing—that we must have proper tools to work with; that a powerful fleet is an absolute necessity for the maintenance of our national honor.

While I agree with the essayist that we will probably never attempt the invasion of the territory of a transoceanic enemy, still I can conceive of a condition of affairs which might make it advisable to capture and hold portions of that territory as a secondary base for blockading; and quite as large a fleet would be required for the one as for the other.

As to the composition of the fleet, I agree with the essayist in the main. I think his proportions are good, and I like his idea of scout vessels. As for commerce-destroyers, we should get them from the merchant service and build no more Columbias. It is well that we have the Columbia and Minneapolis, because they can be used as transports in peace times.

Every officer that has served on a foreign station knows what a serious handicap it is not to be able to send home the sick and the prisoners and to receive drafts periodically to fill vacancies. If the Columbia and Minneapolis were used as transports they would add greatly to the efficiency and *discipline* of foreign stations, and would always be sufficiently near their fields of operation for war.

I accept with pleasure Mr. Ellicott's estimate of the number of vessels of each class required for our fleet. By all means let us unite on it or something substantially the same, and when we get them, if we then think that they are insufficient, let us ask for more, and, above all things, let us fight shy of expensive novelties in naval architecture which are always "going to," but seldom do "revolutionize naval warfare."

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

THE SEA AND SEA POWER AS A FACTOR IN THE HISTORY OF THE UNITED STATES.

ADDRESS OF THE HON. H. A. HERBERT, SECRETARY OF THE NAVY, BEFORE THE CLASS AT THE U. S. NAVAL WAR COLLEGE, NEWPORT, R. I., AUGUST 10, 1896.

In the early part of the seventeenth century the inspired code of Christian ethics was profoundly impressing the human mind throughout all Western and Southern Europe, the literature of liberty handed down through the dark ages from Greece and Rome was also an active living force, and these two forces had nowhere else so successfully co-operated to form free, just and stable government as in the British Isles. It was there that Hampden and Sidney had already lived and died, and it was there that the people had even then made good their claims to the protection of the Magna Charta, of the Petition of Right, and the Bill of Rights. True religious liberty was, however, as yet unknown even in England, and to secure for themselves and their posterity this right and the blessings of self-government, the love of which had been instilled into them by English institutions, the early settlers of the American colonies braved, in the little ships of that day, the dark waters of the wide Atlantic. Some of the immigrants came from Holland and other countries by the sea, but it was the English language, English laws and English ideas that were to dominate in all the thirteen historic colonies.

Fortunately the newcomers found here a virgin soil in which to sow the seeds of liberty. No monarchical establishments stood in the way, no ideas of caste and privilege were to be eradicated. The wide Atlantic had kept the soil intact until man was ready to plant in it free institutions.

The settlers of the colonies sat themselves down close to the

sea and to the rivers that ran into the sea. It was the sea and the rivers that ran into it that were to furnish them their means of transportation and intercommunication, and it was the three thousand miles of ocean, separating them from the home government to which they owed allegiance, that rendered it impracticable for that government to dominate them completely. It was the wide expanse of sea, therefore, to which the American colonies were largely indebted for the measure of self-government they enjoyed even when not yet ready to assert their complete independence.

When the war of the Revolution began, the geographical position of the colonies, all lying along or near the shores of the Atlantic, was in a military point of view especially disadvantageous. Their coast stretched over 1883 statute miles, and all along this entire line their indisputable possession of the sea enabled the British to select bases from which to sever communication between the widely separated armies of the colonies.

The colonists did not surrender the seas without a struggle; they were naturally a seafaring people and made many gallant fights upon the ocean. In October, 1776, the colonial government had, building and built, twenty-six war vessels, though many of these never got to sea. Several of the colonies had built vessels of their own, and such was the activity of American cruisers that they were said to have captured altogether in 1776 as many as three hundred and twenty sail. Many supplies and munitions of war that were to be useful in the long struggle to follow fell into their hands. In 1778 the American cruisers captured and destroyed four hundred and sixty-seven sail of merchantmen, and throughout the war such was the enterprise and courage of American sailors that British shipping was always more or less in danger. In 1779 Paul Jones made his celebrated cruise in the Bon Homme Richard and captured the Serapis after one of the most memorable battles in the history of naval warfare.

But the little fleets of the Americans were eventually swept from the seas. Their successes whenever achieved had served to inspire hope in the patriot armies, but the enemy was never seriously crippled by anything the colonies could do at sea—he was only exasperated.

Arnold's gallant struggle for the control of Lake Champlain

promised results that were really strategically important, but his efforts ended in defeat, and Lake Champlain and Lake George were left in the hands of the British. The Americans soon had of their own resources nothing to rely on but their land forces. Communication between these was over such extended lines, and marches of armies and transportation of supplies over the bad roads, which through the interior connected the colonies together, were so difficult, that the cause of independence was plainly hopeless without the aid of some naval force.

The British at different times established on the Penobscot, at Newport, at Gardiner's Bay, in the Chesapeake, at Charleston and Savannah, bases from which they could carry on offensive operations, and quite often it happened that they were able by their ships to relieve their troops from distress. In the very outset of the war the British army at Boston, besieged on Dorchester Heights, must have surrendered but for the fleet which came to its assistance and carried it away to Halifax. That same year a fleet seized New York and the British held it during the whole war as a permanent base, thus interposing between the American forces operating in New England and those in the South and West.

It was fortunate for the cause of independence that steam was not being used in those days as a propelling power of vessels. Clinton with a fleet of swift and sure steam war-ships and transports might have sent an expedition promptly to the relief of Burgoyne, who had cut loose from his base on Lake Champlain, and that general need not have surrendered at Saratoga. So also if the British fleets had been propelled by steam they could have promptly forced their way up the Delaware, and Philadelphia must thus have fallen long before it did. As it was, the capitol city of the new government when it did fall was captured by an expedition escorted by naval vessels up the Chesapeake and landed at Elkton, on the Elk River near by. The city thus captured by the sea power of Great Britain was relieved by the sea power of France; it was evacuated and the British troops were transported down the Delaware to New York for fear the mouth of the river should be blockaded by the French.

Nowhere during the long continuous struggle was the effect of the failure or success of British naval operations more apparent than in the South. The attack on Charleston in June, 1776,

failed, and as a consequence of that failure South Carolina remained in the hands of the Americans for three years. Afterwards, in 1780, when Charleston fell before a combined attack, South Carolina was overrun by the British. Savannah was captured in 1778 and Georgia was overrun. The force that under General Greene regained South Carolina and Georgia had made long and tedious marches from Virginia.

Situated as the colonies were, it soon became apparent to Washington, their great leader, that the sea power of the enemy gave him an advantage that rendered well nigh hopeless the cause of independence unless the Americans also could call sea power to their aid. Fortunately, at last, aid was to come from France. Washington communicated with De Grasse, the commander-in-chief of the French fleet, and made with him the combinations that were to result in the surrender of Cornwallis and his army at Yorktown. He subsequently put the case thus, in view of the next campaign:

"With your Excellency I need not insist upon the indispensable necessity of a maritime force capable of giving you an absolute ascendency in these seas. . . . You will have observed that, whatever efforts are made by the land armies, the Navy must have the casting vote in the present contest."*

When the French and American forces beleaguered Cornwallis by land, and De Grasse with the French fleet held fast the lines of escape by water, the British commander surrendered his army and independence was won.

In the War of 1812 similar conditions existed. The United States had grown from three millions to over six millions of inhabitants. It had a small Navy whose gallant deeds in that war shed imperishable luster upon officers and men. There is no portion of our history over which the patriotic American lingers with more of pride than over the terrible combats our ships fought with the English, whenever the chances of battle were at all equal. But these duels at sea and the very considerable damage inflicted upon English commerce decided nothing. In spite of its gallant struggles, our little Navy of that day was practically swept from the seas by the British almost as effectu-

* Washington to De Grasse: Letter dated Headquarters, 28 October, 1781, eleven days after the surrender of Cornwallis.

ally as in the Revolutionary war. The enemy chose his points of attack along a line of sea-coast that extended from the northern part of Maine to the western boundary of Louisiana. The means of communication, of transporting troops and supplies from one portion of our country to another were almost as primitive as in the war of the Revolution. The British landed expeditions on the borders of the lakes from Canada, in New Orleans from the Gulf of Mexico, and through the Chesapeake Bay, striking at the center of our long line of sea-coast. They succeeded in capturing Washington and destroying the capitol of the United States.

A naval expedition, during the War of 1812, out on the high seas; or on one of the great lakes, upon our Northern border, headed for no one knew what point upon our shores, with no spies to report its purposes, with no pickets to tell of its movements, was naturally an object of undefined terror. The unexpectedness with which expeditions thus appeared from Canada was doubtless one of the causes contributing to the demoralization which American historians confess with so much reluctance to have existed, during the larger part of the war, among the American troops, especially along our Northern border. No government can by any plea whatever justify a state of unpreparedness for war. As our country was situated in 1814, after our little Navy had been driven from the seas, whether or not it successfully resisted an expedition sent by water against any part of its soil, depended as a rule, on luck rather than on the courage of its people, or the strategy or generalship, of its enemy. The British captured Washington because the Americans were not in luck; they were struck at a point which, it had been supposed, would not be assailed, and which they were not prepared to defend. In the battle of New Orleans we were in luck; we were able to assemble troops there and we had a general to lead them.

The victories won by Macdonough on Lake Champlain, by Perry on Lake Erie, and by Andrew Jackson at New Orleans raised our prestige and, together with the gallant deeds of our little Navy on the high seas, brought us out of that war with credit. But here again was illustrated, as in the Revolutionary war, the vulnerability of our long lines of coast and the absolute necessity to the United States of a navy.

When the great Civil War of 1861 came on, conditions had changed. The population of the United States had grown to thirty millions. It had extended westward to and even beyond the Rocky Mountains. A distinctive feature of the situation then was that, for intercommunication, water transportation was being supplemented and to some extent supplanted by railroads. There was indeed a network of railroads covering the whole country—the South as well as the North—but notwithstanding this, transportation by water was nevertheless a factor in the great struggle about to ensue, that was quite as potential and, in some respects, even more decisive than in the war of the Revolution and of 1812.

The Confederacy, strategically considered, was largely a compact body of states. Its railroad communications, though not equal to those of the North, were nevertheless sufficient. When the armies of the Union sought to invade its territory from different points, the Confederacy had the advantage of interior lines. By these lines it might have concentrated its armies now upon one and then upon another point, in such manner possibly as to have given it ascendency; but all the advantages which would otherwise have been derived from interior and shorter lines were completely neutralized by the naval power of the United States.

The Confederacy had entered upon this conflict for independence without a navy; it struggled manfully to create one. It constructed here and there good ships and fought them gallantly, but they were unequal to the forces they were to meet. The career of destruction upon which the Merrimac had successfully entered at Hampton Roads was arrested by the Monitor. It was not long after this combat that the Confederates felt compelled to destroy their famous vessel to prevent it from falling into the hands of the United States.

The Albemarle, the Mississippi, the Arkansas, the Tennessee, and other ships, constructed with so much pains and industry by the Confederates out of their slender resources, fell one after another into the hands of the enemy or were destroyed. Speaking largely, the Confederacy therefore had no navy. The exploits of the Alabama and the Shenandoah, when noised abroad through the Confederate army, were well calculated to improve its morale and certainly did inspire its soldiers with the belief that the destruction being wrought in the enemy's commerce would

aid in bringing the United States to terms. But it can scarcely be alleged that these ships were of any real value to the cause of the Confederacy. The destruction of commerce, amounting in value to about $15,000,000, did not seriously cripple the immense resources of the United States. It assuredly did not dispirit the armies of the Union or incline its voters to make peace. On the contrary, the moral effect of these raids upon commerce, although they were sanctioned by the cruise of Paul Jones in the North Sea during the Revolutionary war, and of the Essex and other ships during the War of 1812, was only to exasperate the people of the United States and to excite them to still more patriotic efforts, if possible, to put down the Confederacy, which, as the people were then taught by their newspapers to believe, was resorting upon the high seas to piratical and uncivilized methods of war.

The military situation of the Confederacy was this: Five millions two hundred thousand of white people had engaged in a desperate effort to establish and maintain their independence; they had four millions and a half of slaves to produce food and cotton; they had iron and coal in abundance, but were without furnaces or foundries or workshops; they were poorly supplied with arms; they were at the time producing the cotton that clothed the world, but they had few cotton manufactories and practically no other factories whatever; they had imported everything they used except what was produced from their soil. With cotton they might have bought ships, arms and munitions of war, and might have maintained abroad the financial credit of their government. But the United States Navy was everywhere at their doors; every part of the long line of sea-coast which hemmed them in was successfully blockaded; instead of the abundant supplies of things, essential to their home life and the life and success of their armies, which would have come to them had they been able to assert dominion over the sea, only scant articles of necessity were brought in now and then through the blockade. The advantage of the interior lines of communication which the Confederates would otherwise have enjoyed was neutralized by the necessity of keeping garrisons in Wilmington, Charleston, Savannah, Brunswick, Pensacola, Mobile, New Orleans, Galveston, and other ports. It was impossible to say when an army might be landed at any one of these points. Who

shall estimate the value to the United States of the services of its Navy which thus isolated the Confederacy, cut it off from communication with the outside world, and at the same time compelled it to guard every point against a raid like that which had destroyed the capitol of the United States in 1814?

Had the Confederacy instead of the United States been able to exercise dominion over the sea; had it been able to keep open its means of communication with the countries of the Old World, to send its cotton abroad and to bring back the supplies of which it stood so much in need; had it been able to blockade Portland, Boston, Newport, New York, the mouth of the Delaware and the entrance of Chesapeake Bay; had it possessed the sea power to prevent the United States from dispatching by water into Virginia its armies and their supplies, as the United States was blockading and intercepting everywhere *its* supplies, it is not too much to say that such a reversal of conditions would have reversed the outcome of the Civil War.

But this brief generalization of the results of naval operations on the Chesapeake and on the high seas as they affected the military operations, gives no adequate idea of all that was really wrought by the Navy of the United States during that memorable conflict. When the Civil War came on, the influence of sea power had become vastly extended by reason of the changes which had been wrought by the substitution of steam for sail in the propelling of vessels. Every river that permeated the Confederacy was to bear upon its bosom a hostile fleet. Fortress Monroe speedily became a great base of supplies, and the gunboats above it on the James River were a continual menace to the capitol of the Confederacy. When McClellan's army, routed on the battle-field of Chickahominy, eventually made a successful stand upon Malvern Hill against the victorious troops of General Lee, the gunboats in the James powerfully aided in repelling the desperate assaults upon that position, by hurling huge shells from 15-inch guns into the charging columns of the Confederates; and finally the war was practically closed by the army under Grant operating along the line of the James. This line had been opened and kept open by the Navy, and it ran from Fortress Monroe as its base, which base had been successfully maintained for four years by the Navy of the United States.

Port Royal, captured and securely held by the Navy, became

a base of operations which continually threatened both Charleston and Savannah. These two cities were thus both beleaguered at the same time by the naval force at Port Royal, and the Confederacy dared not for a moment send away from them troops that otherwise might have filled up the ranks so terribly depleted upon the battle-fields of Virginia, Maryland and Pennsylvania.

Pensacola when it was captured became another base of operations, necessitating continual vigilance and watchfulness by Confederate troops to prevent incursions into Alabama and Florida. Farther west and permeating the very heart of the Confederacy were the Ohio River, the Tennessee, the Cumberland and the Mississippi like a great inland sea dividing the Confederacy in twain; and flowing into the Mississippi were the Yazoo, the Big Black, the Arkansas, the White and the Red rivers. All these were scenes of naval operations.

One of the first victories achieved in the West was at Fort Henry, where the Confederates, after a brilliant attack by the gunboats, were compelled to surrender to the officer in command of them. The demoralizing effect upon the Confederates of this engagement was quickly followed up by the battle at Fort Donelson, in which the gunboats co-operated, and by a raid of gunboats far up the Tennessee River and into the heart of north Alabama, near Florence. On both the Tennessee and Cumberland and throughout all the territory in Tennessee and north Alabama traversed by these rivers, "Yankee gunboats" soon became common, and they were a continuing menace and annoyance to the Confederates, who in the outset had little counted upon this factor in the conflict upon which they had entered.

Numerous engagements occurred between shore batteries and gunboats, and the moral effect produced by these vessels is vividly remembered by every intelligent Confederate who followed carefully the progress of events. Sometimes the victories in these combats between the batteries on shore and the "tinclads," as they were called because their armor was thin, were with the batteries, and ex-Confederates remember to this day the great joy that spread throughout the Confederacy when it was reported, as it sometimes was, that gunboats had been overcome by horse artillery. It would be difficult to overestimate the value to the Union of the services rendered by the frequent and so often unlooked-for incursions of vessels of war into the heart of the Confederacy.

John H. Morgan, the celebrated raider, was really captured by the gunboats on the Ohio when returning from a raid which had otherwise, at least in part, been successful. He was taken prisoner with the remnant of his command because the gunboats following along the river prevented him from recrossing the Ohio.

The value of the Mississippi River was early apparent, and the government at Washington sent expeditions along it contemporaneously from the North and the South. Farragut, after having passed and captured in a desperate fight Forts Jackson and St. Philip, took possession of New Orleans, the principal city of the Confederacy. Nothing accomplished by the armies of the Union up to this time was equal strategically to the capture of this great city, which was never retaken.

Porter and Davis came down the river from Cairo, and after a desperate combat succeeded in passing the batteries at Vicksburg, thus temporarily effecting a junction with Farragut's fleet from below. But the Mississippi did not as yet pass permanently into the hands of the Union forces. Island No. 10, above Memphis, by the combined efforts of the naval and military forces had previously been captured with its garrison. After the passage of Vicksburg by the upper Mississippi fleet, the Confederates made a desperate effort to keep the river closed from Vicksburg to Grand Gulf, between which points was the mouth of the Red River. Farragut had found it necessary to fall back and join his fleet below Grand Gulf, which could not be passed without serious loss; and Porter, while Vicksburg and its batteries remained in possession of the enemy, found it impracticable to maintain permanently the stretch below. The Mississippi between Vicksburg and Grand Gulf therefore remained for months in the hands of the Confederates, who improved, as far as their resources permitted, their armaments at these two points and also at Port Hudson, which lay between them. Some of the most desperate fighting of the Civil War occurred at these points between the Union gunboats and the batteries on shore, the Confederates retaining their positions with great tenacity. From the country tributary to the Red River they were drawing valuable supplies for their armies farther east.

As part of these naval operations in the Western rivers, gunboats ran up the White River as far as Duvall's Bluff, where

they destroyed the bridge of a railroad leading from Little Rock eastward. They also made excursions up the Yazoo River and the Big Sunflower, destroying gunboats the Confederates were building, as well as vast quantities of supplies that were being accumulated in that rich alluvial country.

These incursions of the gunboats into the interior were of course not always successful; many brilliant and gallant feats were done in the encounters which ensued, both by the Federal and Confederate forces.

In the summer of 1863 Grand Gulf and Port Hudson fell, and finally, on the 4th day of July, Vicksburg with its garrison surrendered, thus opening permanently to the forces of the Union the Mississippi River. The capture of all these places was effected in large part by the armies of the United States, but in each and all the operations leading up to these results the co-operation of the naval forces was effective and absolutely essential.

When the Mississippi River had finally throughout its whole length passed permanently into the possession of the Union, it soon began to be apparent that the Confederacy, hemmed in on all sides, cut in two and threatened in so many directions by the naval and land forces of the United States, could not long survive the unequal contest it was waging.*

* The part performed by the Navy, during the Civil War, has been commented upon by military writers abroad. "To overcome the dangers springing from so formidable an insurrection," wrote the Prince de Joinville, "three results must be obtained: The shores of the Seceding States must be effectively blockaded; the course of the Mississippi and the whole water system of the West must be mastered; finally, the rebellious government must be driven from Richmond, its chosen capital."

Starting from these broad lines, the late Charles Cornwallis Chesney, colonel in the British Army and lieutenant-colonel in the Royal Engineers, one of the ablest of military writers of his day, observes that "the important part borne by the American Navy in the contest; its absolute performance of the first portion of the task indicated by the Prince; the powerful share taken by it in the river campaigns, which cut the Seceded States in twain; the vast weight due to its exertions in the final successes of the Federal generals, had been but little noticed as compared to the din and shock of the great battles with which the New World rang. Yet nothing is more surprising in this great contest; no military, political, or financial success more completely defied expectation, prophecy, and precedent than the work wrought by this arm of the Union forces; and wrought by it in the very process of creation out of actual nonentity."

To this we may add the views of General Viscount Wolseley. That

It may be of interest here to note the much larger degree of success achieved by the Union forces prior to the summer of 1863 in the Southwest than in the East. The armies of the Tennessee and of the Cumberland had, as their names imply, rivers along which to operate and gunboats to help them on these lines, and by the spring of 1863 these armies had won many victories and made substantial advances. The army of the Potomac, though large and well equipped, and though its soldiers fought gallantly, had accomplished little. This army had been operating mainly along lines where the naval forces of the Union could not help it; there were no rivers along which gunboats could ply. It was, as has heretofore been said, only when it changed its base of supplies to Old Point Comfort and operated along the line of the James, opened and held for it by the Navy, that this great army succeeded in winning and keeping the territory for which it was fighting.

Of course it is not possible within the limits of a single lecture to properly apportion between the Army and Navy credit for the final outcome of our great Civil War. So complex were the operations of these two arms of the service and so intimately interdependent were they that the solution of the problem suggested would require at the hands of a great strategist a thorough analysis of the whole history of that wonderful struggle. I have attempted no such task; only a brief review to recall facts which, if not forgotten, have apparently been underestimated by the general public.

The operations of the Civil War were carried on upon an extensive scale. There were enlisted in the armies of the Union

distinguished authority has expressed the opinion that, for Englishmen, the naval operations of the Civil War have a quite peculiar importance. "The co-operation of the United States Navy with their Army," he says, "in producing a decisive effect upon the whole character of the military operations, is akin to what happens with us in nearly every war in which we engage." "An English general has almost always to make his calculations strictly in accordance with what the navy can do for him. The operations by which the Federal Navy, in conjunction with the Army, split the Confederacy in two and severed the East from the West, must always, therefore, have for him a profound interest and importance. The great strategical results obtained by this concentration of military and naval power, which were as remarkable as the circumstances under which the successes were gained, deserve our closest study."

Other authorities might be cited bearing upon the same point.

EDITOR.

altogether 2,672,341 men; the Navy never at one time contained more than fifty-two thousand. The armies represented every hamlet in the United States; there were very few of the older families that did not have some blood relative in their ranks. Soldiers returning to their firesides naturally familiarized their friends and neighbors with the exploits of the armies in which they had served; and these soldiers have, in large part, written the history of the war. Regimental, brigade, division and corps histories have been published almost without number. Soldiers and their intimate friends numbered by the millions have been the readers of these books, while those who were personally concerned in the operations of the Navy were relatively few, and most of them were common sailors, drawn largely from the merchant marine. These men have not written, and they have not to any great extent read histories; but they were men who, with the officers of their corps, helped to make history during the trying times of the Civil War, and their deeds have never been exploited before the public as they deserve to be. The historian who shall take up the subject, with the time and ability to do justice to it, will render an invaluable service to his country. He will not only rescue from the partial forgetfulness into which it has fallen one of the most brilliant chapters of that memorable war, but he will also set clearly before the public mind the influence of sea power as a factor in the past history of this country. This he will never be able to do without demonstrating, at the same time, that we cannot afford to be without a navy in the future.

The situation as it was during the Civil War may be, to some extent, repeated in the future in a war with a foreign naval power. The sea-coast over which the Confederacy was annoyed and attacked is still the sea-coast of the United States, and added to that is the coast from Maine to Cape Henry and from Puget Sound to the Gulf of California. All this is assailable in the future, and all this is to be defended by the United States. It is not at all likely that any foreign country could, with success, invade the interior of our country, but we are still vulnerable from the sea. Our ports can be blockaded, our commerce can be destroyed, we can be isolated from the world, our flag can be humiliated and insulted unless we understand and appreciate the value of sea power. We must stand always ready and able

to defend and maintain the integrity of our country, its honor and dignity at home and abroad.

In conclusion, Mr. President and gentlemen, I am glad to have the opportunity of making the contribution, insignificant as it is, to the literature of the War College, a grain of mustard-seed cast into what I know to be fertile soil.

This institution is at last, I think, on a sure foundation and destined to become a permanent feature in our naval administration. For its present position and future prospects it is indebted primarily to the officers who have had it in charge, and secondarily to the zeal and fidelity with which those sent here, year after year, have lent themselves to the honest work they found awaiting them within these walls. The Navy, for this College, owes a debt of gratitude to Admiral Luce, who was its early and fast friend; to Captain Mahan, who made a world-wide reputation by the lectures he delivered here; and to Captain Taylor, who has brought it to its present state of efficiency in practical work.

The opinion was once widely entertained that this College was intended for a post-graduate course and that, this being so, it should be located, if allowed to exist at all, at the Naval Academy. I was of this opinion myself until three years ago on a personal visit I inspected its workings and examined fully into its plans and purposes. Then I discovered, what the public is beginning to understand, and what the Navy itself is now coming fully to appreciate, that it is in no sense a post-graduate course that is being pursued in these walls; that not only are the theory and art of war being thoroughly studied and developed here, but knowledge is being acquired and practical information is being amassed without which the Navy Department cannot possibly, in the event of war, utilize the naval resources of our country.

Ships and guns, and torpedoes and men, are all of little use unless officers know how to fight them. Individual ships, however bravely and skilfully they may be handled and fought, can accomplish but little if officers do not know when, where and how to dispose them; while at the same time skill in handling, courage in fighting, and knowledge of the proper disposition of ships in battle, will often all be of little avail without continual and prompt supplies of everything needed in the exigencies of war, all of which must be reckoned for beforehand. Successful

war means all of these things and more besides. It means, if the exigency requires, the exertion by a nation of its utmost power, the utilization of all its resources, the tapping of every source of supply, the employment of every manufactory, every ship and every man that can be useful, and all this with the utmost promptitude and dispatch. Further than this, plans of attack and defense must be devised, and these cannot be successfully made without the most accurate knowledge of harbors, inlets, safe and unsafe passages, tides and everything else pertaining to the possible theaters of impending war. A study of these and of still other problems constitute the work which, I am glad to say from a careful personal inspection of results, you have been successfully performing during the years just passed. I congratulate you, gentlemen, and you particularly, Mr. President, upon the results you have achieved. For myself I shall rejoice, if when I shall lay down the office I now hold, it can be said I contributed, in such a manner as I could, to the successful workings of this institution.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

HOWE AND D'ESTAING.

A STUDY IN COAST DEFENSE.

By Commander C. F. Goodrich, U. S. Navy.

A hundred years after De Ruyter's time, the flames of war burst out in every quarter of the globe where Englishmen could meet Frenchmen, Dutchmen or Spaniards, or where colonies and commercial outposts were to be won and lost through fighting on the land or on the sea. To this general conflagration the newly born United States, adding their quantum of fuel, appeared before the world as a nation, poor, weak and scattered to be sure, but still not to be neglected in itself, and entering as a factor in the solution of the perplexing problem whose importance depended purely upon its ability to create a serious diversion remote from the larger issues at stake.

It is foreign to my purpose to write afresh the history of this great war so fraught with consequences that reach down even to our own day, but a general conception of the different theaters of operations is essential to a right understanding of the special occurrences in which our forefathers were deeply interested. We shall gain from this larger view some valuable light on the strategic policy of the attack in a theater of naval war which comprised nearly every navigable sea, and we shall be in a better position to understand the limitations which marked the operations of the British and French fleets on our coast in 1778.

The War of Independence began when England was exceptionally free from entanglement. Still she was not entirely without apprehension of difficulties nearer at home. There were certain grievances between her on the one hand, and France and

Spain on the other, which might lead to grave trouble, and both of these powers had recently made such notable additions to their fleets as to threaten to compromise British supremacy.

Had the British ministers realized to what extent the dissatisfaction in the American colonies would develop, or the vast importance of England's concern there, they would have acted more promptly and effectively and have endeavored to crush the rebellion before it had made serious head. Instead of immediately despatching a force ample for the speedy reduction of the revolting colonies, and thus finishing at one stroke that comparatively easy task, the British government sought present economy at great subsequent loss; the war dragged along with varying fortunes for several years until, in 1778, France recognized the independence of the United States and joined in the struggle against England, to be followed a year after by Spain and Holland. The chance for success in America had passed by, and England found herself fighting at once in every corner of the known world.

For a critical discussion of this great maritime war reference may be made to the concluding chapter of Captain Mahan's first volume. We are only concerned in the general drama so far as is necessary to gain a right understanding of the objects of the allies:—viz., first the destruction of England's supremacy, second France's territorial expansion in the West Indies, third the recapture from the English of Minorca and Gibraltar, fourth the invasion of England itself, fifth the weakening of England by aiding the colonies in their insurrection. In general terms, the downfall of England's commercial supremacy was France's object, and the restoration of Minorca and Gibraltar that of Spain. All else was subsidiary. And England was essentially on the defensive.

As her commercial superiority was, ultimately, based upon England's fleet, the true objective of the allies was that fleet. Suffren alone among the commanders grasped this fundamental idea, and he alone won laurels to be envied of all. With this general error in strategy at the outset it is not strange that the allies failed to achieve their major aims. The annals of the war tell of numberless insignificant affairs, but of few possessing a determining importance like the fall of Port Mahon, Rodney's victory over De Grasse, April 12th, 1762, or De Grasse's holding

the mouth of the Chesapeake against Graves, which precipitated the surrender of Cornwallis.

There were operations of both a naval and a military nature at points abroad: Gibraltar was besieged and relieved, blows were exchanged in the East and West Indies, but the invasion of England was never even attempted.

One phase of the war which is of especial value to us occurred in 1778 when d'Estaing sailed, on the declaration of hostilities by France, to the relief of the American colonies.

The local military situation at this moment may be thus described. The British army was in Philadelphia, with Washington's force close at hand. New York had been in possession of the British since July, 1776, and was their base by every reason, geographical and political. As soon as the English government had news of d'Estaing's contemplated sailing, orders were sent to America to evacuate Philadelphia and concentrate on New York. The mere threat of d'Estaing's coming forced the British back on their base with all speed. The integrity of their line of communications became paramount.

News traveled slowly in those days, and d'Estaing seems to have traveled even more slowly. "It is said that he wasted much time in drills, and even uselessly." However that may be, he did not reach his destination, the Capes of the Delaware, until the 8th of July, making a passage of twelve weeks from Toulon, of which four were spent in getting out of the Mediterranean. Lord Howe's movements were in marked contrast with d'Estaing's. "First, assembling his fleets and transports in Delaware Bay, and then hastening the embarkation of stores and supplies, he left Philadelphia as soon as the army had marched from there for New York. Ten days were taken up in reaching the mouth of the bay [through calms], but he sailed from it the 28th of June, ten days before d'Estaing arrived, though more than ten weeks after he had sailed. Once outside, a favoring wind took the whole fleet to Sandy Hook in two days. War is unforgiving; the prey that d'Estaing had missed by delays foiled him in his attempts upon both New York and Rhode Island."*

"The day after Howe's arrival at Sandy Hook the English army reached the heights of Neversink after a harassing march through New Jersey, with Washington's troops hanging upon

* Mahan.

its rear. By the active co-operation of the navy it was carried up to New York by July 5th, and Howe then went back to bar the entrance to the port against the French fleet, whose arrival on the Virginia coast had been observed and reported."*

"The problem before him was to defend a practicable pass with six sixty-four gun ships and three of fifty, against eight of seventy-four guns or more, three sixty-four and one fifty,"* practically double his own force.

Had d'Estaing entered immediately on reaching Sandy Hook, he would have encountered but little resistance, for a number of Howe's ships were up the bay, but, instead, he anchored off the bar, afraid to cross. Here he spent eleven precious days in sounding out a channel. In the meantime Howe ranged his ships in a curve inside the Hook and anchored them head and stern so as to command the channel. Two small batteries were placed on the shore flank, one of two howitzers, one of three 18 pounders. It is needless to go into further details.

On the 22nd of July, 1778, "a high northeast wind coinciding with a spring tide, raised the water on the bar to thirty feet. The French fleet got under way and worked up to windward to a point fair for crossing the bar. Then d'Estaing's heart failed him under the discouragements of the pilots; he gave up the attack and stood away to the southward."

Captain Mahan says of this incident: "Naval officers cannot but sympathize with the hesitation of a seaman to disregard the advice of pilots, especially on a coast foreign to him; but such sympathy should not close their eyes to the highest type of character. Let any one compare the action of d'Estaing at New York with that of Nelson at Copenhagen and the Nile, or that of Farragut at Mobile and Port Hudson, and the inferiority of the Frenchman, as a military leader, guided only by military consideration, is painfully apparent. New York was the very center of the British power; its fall could not but have shortened the war. In fairness to d'Estaing, however, it must be remembered that other than military considerations had to weigh with him. The French Admiral doubtless had instructions similar to those of the French minister, and he probably reasoned that France had nothing to gain by the fall of New York, which might have led to peace between America and England and left

* Mahan.

the latter free to turn all her pressure against his own country. Less than that would have been enough to decide his wavering mind as to risking his fleet over the bar."

This suggestion is quite true and is conceived in the author's well known charity of thought, but it appears that if d'Estaing was unwilling or forbidden to unduly hazard his ships, they would have been quite as effective at Toulon as off Sandy Hook, and that lack of backbone was the real cause of his failure to press home his advantage.

D'Estaing's own account reads thus: "Both officers and crews were kept in spirits . . . by the desire of delivering America from the English colors, which we saw waving on the other side of a simple barrier, on and upon so great a crowd of masts. The pilots procured by Colonels Laurens and Hamilton (under Washington's direction) destroyed all illusion. These experienced persons declared that it was impossible to carry us in. I offered in vain a reward of 50,000 crowns to any one who would promise success. All refused, and the particular soundings I caused to be made myself too well demonstrated that they were right." [D'Estaing to Congress.]

Reinforcements from England now began to arrive at New York in the shape of straggling vessels of Admiral Byron's fleet, which had been scattered by a heavy easterly gale, and of others.

"On the 28th of July Howe was informed that the French fleet, which had disappeared to the southward, had been seen heading for Rhode Island. In four days his fleet was ready for sea, but, owing to contrary winds, did not reach Point Judith till the 9th of August. There he anchored and learned that d'Estaing had run the batteries the day before and anchored between Gould and Canonicut Islands; the Seakonnet and Western Passages had also been occupied by French ships." [Mahan.] On arriving at Narragansett Bay, d'Estaing immediately proceeded to land 4,000 men to strengthen General Sullivan in his attempt to drive the English out of Rhode Island, but hearing of Howe's appearance off the port, he hastily recalled his landing party, and the prevailing summer S. W. wind having suddenly shifted to the northward, he put to sea with all his fleet.

The next day, August 11th, was spent in manœuvring, for Howe was yet too inferior to engage except when the conditions seemed favorable to him. A violent gale of wind dispersed

both fleets the following night and did much damage, especially to the French ships.

"The English fell back to New York. The French rallied again off the entrace of Narragansett Bay; but d'Estaing decided that he would not remain on account of the damage to his squadron, and, accordingly, sailed for Boston on the 21st of August. Rhode Island was thus left to the English, who retained it for a year longer, evacuating then for strategic reasons. Howe on his part diligently repaired his ships and sailed again for Rhode Island, when he learned of the French being there; but meeting on the way a vessel with word of their going to Boston, he followed them to that harbor, in which they were too strongly placed to be attacked. Taking into consideration his enforced return to New York, the necessary repairs, and the fact that he was only four days behind the French at Boston, it may be believed that Howe showed to the end the activity which characterized the beginning of his operations." [Mahan.]

On November 4th, his repairs effected, d'Estaing sailed from Boston for the West Indies. Sullivan withdrew from Rhode Island.

Speaking of the occurrences thus hastily depicted, Captain Mahan says:

"Scarcely a shot had been exchanged between the two fleets, yet the weaker had thoroughly outgeneraled the stronger. With the exception of the manœuvres for the weather-gauge after d'Estaing left Newport, which have not been preserved, and of Howe's dispositions to receive the expected attack in New York Bay, the lessons are not tactical, but strategic, and of present application. Chief among them undoubtedly stands the value of celerity and watchfulness, combined with knowledge of one's profession. Howe learned of his danger by advices from home three weeks after d'Estaing sailed from Toulon. He had to gather in his cruisers from the Chesapeake and outside, get his ships of the line from New York and Rhode Island, embark the supplies of an army of ten thousand men, move down the Delaware—which unavoidably took ten days—and round to New York again. D'Estaing was ten days behind him at the Delaware, twelve days at Sandy Hook, and only one day ahead of him in entering Newport, outside of which harbor he had lain ten days before sailing in."

"The same industry and watchfulness marked his remaining operations. As soon as the French ships had sailed off to the southward, lookout vessels followed him, and preparations continued (notably of fire ships) for pursuit. The last ship that joined from England crossed the bar at New York on the 30th of July. On the 1st of August the fleet was ready for sea with four fire ships. The accident of the wind delayed his next movements, but, as has been seen, he came up only one day after the entrance of the enemy into Newport, which his inferior force could not have prevented. But the object of the enemy, which he could not oppose, was frustrated by his presence. D'Estaing was no sooner in Newport than he wished himself out. Howe's position was strategically excellent. With his weatherly position in reference to the prevailing winds, the difficulty of beating a fleet out through the narrow entrance to the harbor would expose the French ships trying it, to be attacked in detail; while if the wind unluckily became fair, the admiral relied upon his own skill to save his squadron."

. . . "The sortie of the French, the subsequent gale, and the resulting damage were all what is commonly called luck; but if it had not been for Howe's presence off Point Judith threatening him, they would have ridden out the gale at their anchors inside. Howe's energy and his confidence in himself as a seaman had put him in the way of good luck, and it is not fair to deny his active share in bringing it about. But for him, the gale would not have saved the British force in Newport."

Washington wrote on August 20, 1778, in relation to d'Estaing's further mission: "The length of the passage, in the first instance, was a capital misfortune; for had even one of common length taken place, Lord Howe, with the British ships of war and all the transports in the river Delaware, must inevitably have fallen; and Sir Henry Clinton must have had better luck than is commonly dispensed to men of his profession under such circumstances, if he and his troops had not shared at least the fate of Burgoyne. The long passage of Count d'Estaing was succeeded by an unfavorable discovery at the Hook, which hurt us in two respects—first in a defeat of the enterprise upon New York and the shipping and troops at that place, and next in the delay occasioned in ascertaining the depth of water over the bar which was essential to their entrance into the harbor of New

York. And, moreover, after the enterprise upon Rhode Island had been planned and was in the moment of execution, that Lord Howe with the British ships should interpose merely to create a diversion and draw the French fleet from the island was again unlucky, as the Count had not again returned on the 17th to the island, though drawn off from it on the 10th, by which means the land operations were retarded, and the whole subjected to a miscarriage in case of the arrival of Byron's squadron."

The English were strictly on the defensive, although they were manœuvring in a country which was largely, although not entirely, hostile, and although they had initiated an enterprise of an aggressive nature.

There were two theaters of operations—one, minor, in Rhode Island, where they held Newport and its approaches, the other, major, which included Philadelphia as the front with New York as the base.

These two theaters were dependent upon the sea for their intercommunication, and in the lesser the English were the more vulnerable, although a reverse in this quarter would have been less serious than in the other and greater theater. It was open to d'Estaing to inflict great damage at either, for he was notably superior to Howe, and the troops he carried, though few in number, would have turned the scale in favor of the colonists, whether added to Washington's forces or to Sullivan's.

As an argument in favor of an immediate attack on Howe, and at New York, was the possibility of his receiving reinforcements, and the great desirability of beating him before any contemplated reinforcements could reach him; coupled with the greater effect which would be derived from a blow at or the capture of the English base. Up to the time of his appearance off Sandy Hook, d'Estaing's movements were strategically sound, although marked by a woeful lack of energy. The knowledge of his departure from Toulon was sufficient to make Clinton and Howe rally on the base thus threatened even in a very remote way. Until they could be sure that d'Estaing was bound elsewhere, they were forced back to New York to abandon the ground they had gained at much cost, and were temporarily paralyzed so far as any fresh advance was concerned. Such is the result of any right strategic move.

The reply of Howe and Clinton was correct in its turn, but the conditions of the game and imperative orders from London left them no other course. Howe, perceiving the danger, displayed a zeal and industry beyond praise and saved New York to his side.

At this remote date it is impossible to account for d'Estaing's fatal hesitation off Sandy Hook. He may have been hampered by secret instructions of a military or political nature not to unduly risk his ships in a general engagement, a favorite policy of the French during that century which did their navy much harm, or not to bring matters in America to a crisis, the prolonging of the struggle being more to the advantage of the French than its termination. His subsequent conduct, however, warrants us, in lack of other evidence, in believing that the determining cause was rather moral and subjective, but we must not forget that he did not, as we do, possess the precedent of Copenhagen and the Nile. Profiting by the warning of his example, let us remember in the future that great results in war are seldom achieved without taking commensurate risks. This much seems certain, that he could have entered New York, and that in failing to do so a great opportunity was lost which would have covered him with glory, and doubtless brought the war to a close.

Whether his next step in appearing off Newport was proper or not depends on the motive. If he sought to decoy Howe away from New York with the intention of going in during the latter's absence, it was well conceived, but there is nothing to show that he had this or any other definite scheme in mind. He waited ten days off Point Judith and then ran the batteries at the mouth of Narragansett Bay, apparently forced by necessity into doing, or seeming to do, something—no matter much, what. This motive, a very inadequate and mistaken one, has not disappeared with d'Estaing, and it may return some day to trouble even us, who should be forewarned by the precedents in this case.

Having shut himself into the bay, the key of which lay now with Howe, in his possession of the weatherly position due to the prevailing breeze, d'Estaing found two courses open to him—to assist Sullivan or to seize the first opportunity to escape. He adopted the first only to abandon it in favor of the latter. How earnest his efforts were the next day to cross swords with Howe, his inferior by nearly one-third, is not known. Having

come out of the bay with a leading breeze, he must have been in a position to engage had he really so desired. It is more probable that he was not averse to avoiding actual combat; again displaying that common error, failure to realize that the main objective in naval war is the adversary's fleet. He at all events proved that his entering Narragansett Bay was strategically unsound, unless he had strength enough to help Sullivan, without, at the same time, incurring too great a risk, at anchor, in an assault by Howe, who had the tactical advantages of the wind and the shore batteries on his side.

The succeeding gale diminished d'Estaing's superiority and afforded him an excuse for going to Boston to refit, whence he only sailed to quit the coast.

He seems, therefore, to have been strategically correct at New York, strategically wrong at Newport, and deficient in tactics and seamanship everywhere.

Howe, on the other hand, in command of the defense fleet, exhibited at all stages a professional ability and a personal example well worthy of emulation. His preparation for guarding the channel at Sandy Hook, his manœuvring outside of Newport, his promptness in attacking such French ships as could be engaged on favorable terms are admirable. The essence of coast defense strategy is exhibited by him in using his fewer and weaker vessels at all times so as to impede and harass the enemy, hanging on his flanks, observing him, ready at any moment to profit by a temporary advantage and to strike quickly and sharply. It is furthermore interesting to note that, in this instance of the appearance off our shores of a powerful attacking fleet, it was the defense fleet, although inferior, and not the land works that repulsed the enemy. There appears to be no reason why that which happened in 1778 should be regarded as exceptional in warfare or as failing to add one more convincing proof that, however valuable fortifications may be in harbor defense, ships alone can defend the coast.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

TELESCOPIC SIGHTS FOR GUNS.

By Lieutenant Joseph Strauss, U. S. Navy.

When one considers the accuracy with which modern guns are constructed, the careful inspection and proof of the ammunition, and the ease with which the weapon is manipulated, he is naturally led to expect the best results in target practice. An examination of the target sheets is somewhat disappointing. We know that the gun used can put all of its shots within a three or four-foot circle at a thousand yards, that the men are carefully drilled at aiming and pointing, and we are then compelled to examine the third element in the problem of hitting the target, that is, the means we have provided for actually sighting the gun.

With the ordinary bar sights now in use the gun captain is called upon to see three objects in line, viz., the rear sight, 15 inches distant; the front sight, 50 inches distant; and the target, anywhere from a few hundred to several thousand yards away. To see three, or even two, objects distinctly at such widely varying ranges is an impossibility. The eye without conscious effort will accommodate itself to any distance, but it can only focus for one distance at a time. This can easily be shown by looking through a wire screen held a foot or two from the eye at some object several hundred yards away. The distant object will be distinctly seen, and the wires of the screen will be scarcely visible; and conversely, if we see the screen the distant object will only give a hazy impression. In sighting a gun, then, there must be a compromise effort to see all three objects at once, with the result that they are all indistinct, making the pointing largely a matter of practice and judgment, whereas the angle between the

line of sight and the axis of the bore should be exactly what the sight bar calls for and totally independent of the personality of the gun captain.

Lack of acuteness of vision also militates against good practice with the ordinary bar sight. The front sight being a cone or point, and the rear sight a notch, the front sight would probably appear shorter and the notch less deep to poor eyesight than to good, again bringing in the personal element to the detriment of the gun practice.

It was not until 1801 that sights of any kind were used in aiming guns. Up to that time the men were instructed to look along the "line of metal," or exterior of the gun, and aim at some point of the enemy's ship above the point to be hit. When first introduced, both front and rear sights were fixed and merely gave a line parallel to the bore. This innovation took place nearly 500 years after the introduction of cannon, and was objected to then by as good a man as Lord Nelson. It was not until much later when a French army officer succeeded in introducing movable rear sights graduated to cable-lengths.

Until the beginning of this century it would perhaps have been superfluous to have introduced accurate sighting methods when the gun element had contributed so little to accuracy. The charge was measured out, and if the powder was a little old, a quart or so more was used. Guns were single shotted or double shotted with little thought of the effect on the trajectory. However, the optical defects of bar sights must have been apparent at an early date, for as long ago as 1857, Capt. Younghusband, of the British Army, introduced the telescope as a means of sighting guns. The telescope was mounted on a bar secured to one of the trunnions of the gun and parallel with its axis.

The telescope sight came into more extended use in 1875, when Major Scott, of the British Army, introduced his sight. The telescope is attached to the gun until it is laid, and is removed just before the gun is fired. Its distinguishing feature is an arrangement by which it can be attached to or removed from the gun quickly. It is still issued to the English Army with their 12-pdr. field guns.

About eight years ago Captain Grenfell, of the British Navy, produced an arrangement by which the telescope was mounted on a curved sight bar, the curve being concave toward the trun-

nions of the gun. As the sight bar is raised the telescope is depressed through a corresponding angle equal to the required range, after which the gun is elevated until the optical axis is coincident with the target. This telescope is trained and elevated with the gun.

In 1890, Lieut. Fiske, U. S. Navy, obtained a patent on a telescope sight which had the distinguishing feature of being secured to the shield of the gun, and which depended, more or less, on the roll of the ship to bring the line of sight in coincidence with the target. This arrangement avoided all shocks to the telescope and permitted the gun captain to keep his eye at the sight while actually firing the gun.

The introduction of gun mounts in which the gun recoils in a slide or sleeve in the line of fire solved the difficulty hitherto present in all attempts at sighting guns on shipboard by means of telescopes. This permits us to mount the telescope to all intents and purposes on the gun. The eye can remain at the sight while the gun is recoiling, and all shocks to the telescope are avoided; the gun can be elevated and depressed without disturbing the setting of the telescope, yet the latter partakes of all the movements of the gun except recoil.

The Bureau of Ordnance design includes an ordinary terrestrial telescope fitted with cross-wires, having its optical axis parallel with that of the gun and arranged to oscillate in a vertical plane, or rather a plane making a small angle (equal to the drift angle) with a vertical plane through the axis of the gun, by means of a screw pressing against a rigid arm depending from the barrel of the telescope. Attached to this screw is a drum, upon the periphery of which are marked the ranges. As the drum is revolved to the higher range the screw moves back and allows the front of the telescope to *depress*. The optical axis is then made the line of sight by elevating the gun (and with it of course the telescope) until the target appears in the cross-wires, when the gun is fired. In the case of turret guns the sight is mounted on an oscillating table, which is made to move parallel with the gun by means of a straight rod, the lower end of which is attached to the slide on which the gun recoils, the upper end being attached to the table. This device produces a simple parallel motion between the telescope and gun, and is in effect the same as if the sight were mounted on the gun slide, as in the case of

the smaller guns. It is inadmissible to mount it directly on the slide when the gun is in a turret, for the reason that at low ranges with the ship heeled, or when firing at elevated objects, too large an opening would be required in the turret for sighting through. Fig. 1 explains this.

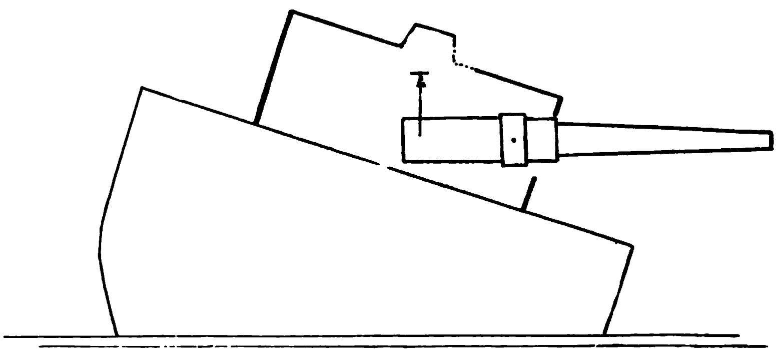


FIG. 1.

Fig. 2 shows the method of applying the sight to a turret gun. *ON* is the arm on the oscillating slide. *B* is a rod connecting the arm *ON* to an arm of equal length keyed to a cross-shaft, to which the telescope table *E* is also keyed. Upon this table rests the telescope stand, so arranged that it can be moved in azimuth by means of the tangent screw *t*. It can also be adjusted in angular altitude by means of the screw *a*. After getting the telescope adjusted these screws are not disturbed until something has occurred to destroy the parallelism of gun and telescope. The rod *B* is provided with a turnbuckle, so that its length may be adjusted to equal the distance between the center of the trunnion of the gun-slide and the center of the cross-shaft.

Fig. 3 shows the telescope as designed for mounting on other than turret guns, the only difference being in the base of the stand. In this case the stand is stepped into a circular socket and clamped by means of a cam. By this means it may be readily shipped and unshipped. *A* is the securing screw for the diaphragm carrying the cross-wires. *BB* are the front and rear finder sights. *C* is the stand. *D*, arm cast in one with the trunnion band, and is provided with a hardened steel piece *E* which takes against the point of the screw. Good contact is

secured by means of the tension spring *F*. *G* is a drum made of aluminum upon which the ranges are marked. It is turned by means of the milled head *H* until the proper range comes next to the pointer *J*. The marks are arranged spirally about the drum, and the pointer is so shaped as to hide all adjacent marks.

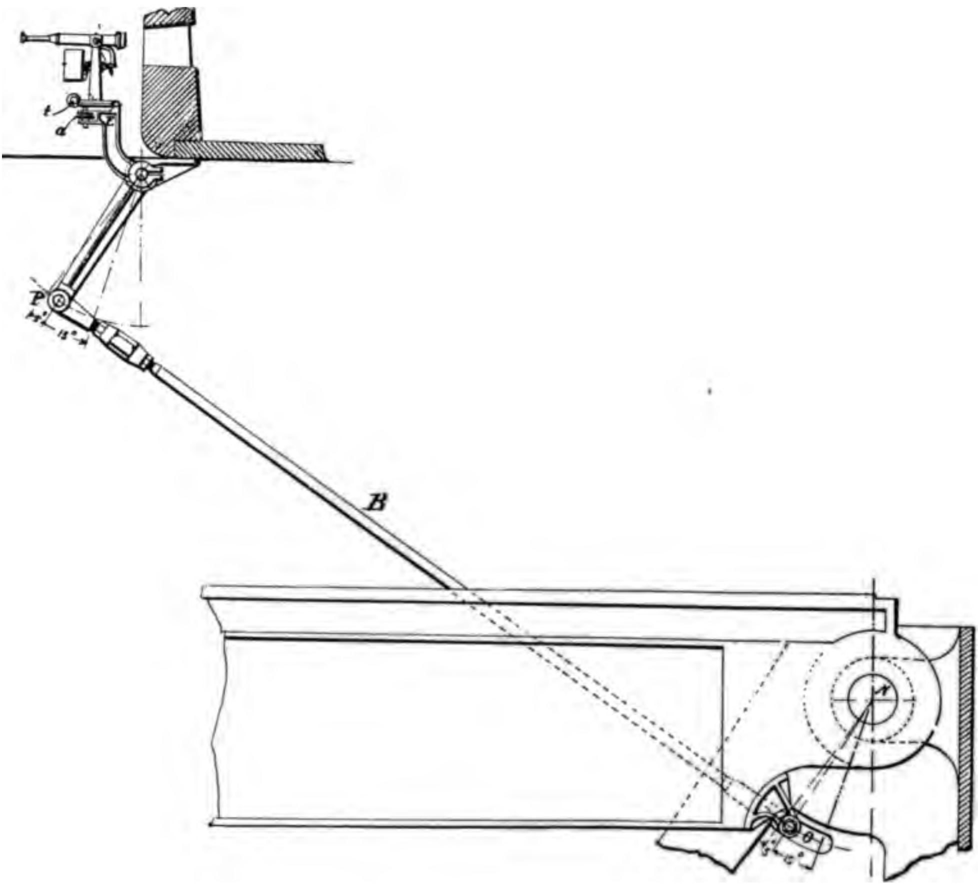


FIG. 2.

The pointer is secured to the stand by the screws *KK*; the slots at these points permit of a small movement of the pointer, so that in adjusting the sight in altitude it is only necessary to bring its optical axis parallel to the gun, after which the pointer can be shifted to the zero mark and clamped. The two bolts *MM*

allow of a similar azimuth adjustment. The set-screw *L* is provided for the purpose of checking any tendency of the drum to

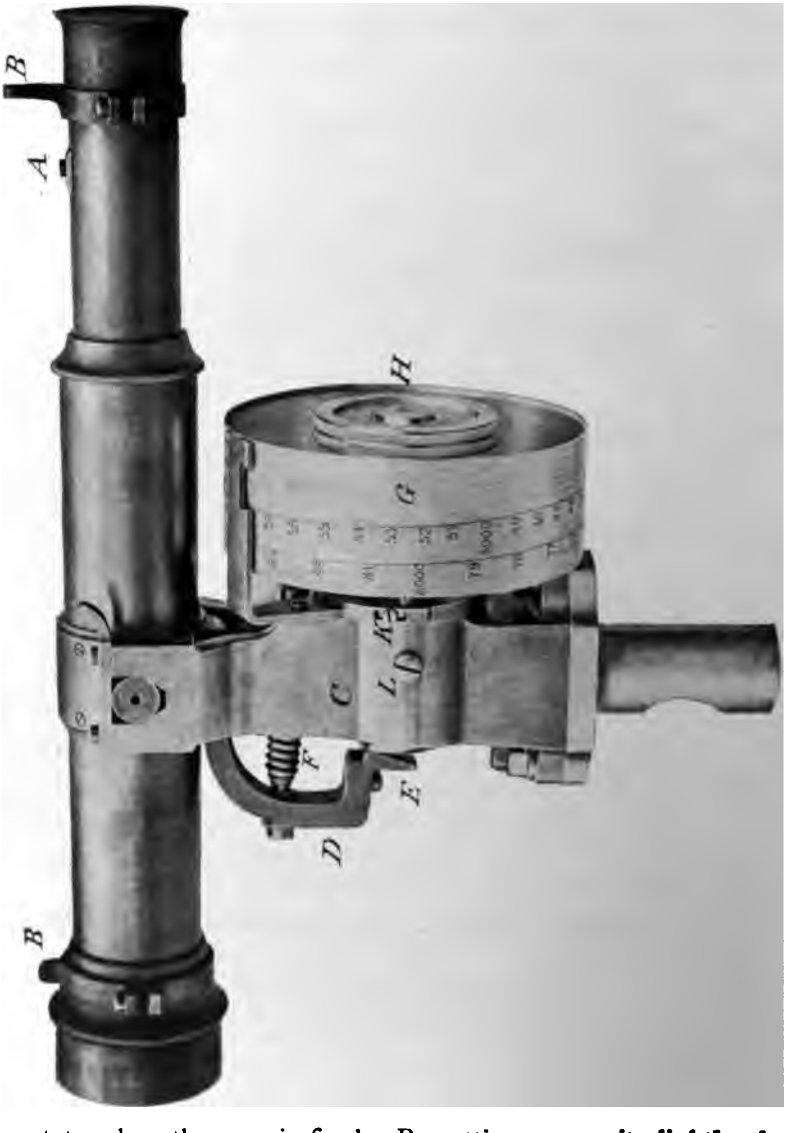


Fig. 3.

rotate when the gun is fired. By setting up on it slightly the friction of the screw is increased at will.

THE TELESCOPE.

The telescope is provided with an erecting eyepiece. Although this increases its length very much and doubles the number of lenses with a consequent loss of light, it is highly necessary that the gun pointer shall not be confused by working with an inverted image of the target.

The vertical cross-wires are double, one on each side of the axis, with a horizontal cross-wire exactly in the axis, all of them being firmly secured in place, so that no adjustment need be made for collimation. The wires are made much thicker than is usual, so that when the sight is used at night they will be plainly visible.

All lenses are firmly secured in place, and no focusing for distance is necessary. The object-lens is made about two inches in diameter so that as much light may be taken in as possible, thereby increasing the value of the telescope as a night sight.

The magnification is about 1.5, and the field nearly 17 degrees. Great care has been exercised to get as large a field as possible, and 17 degrees is the limit with the dimensions allowable. The field of the human eye is about 60 degrees, but probably not more than half that amount is actually used. The fact that the field in the telescope is necessarily much less than that of the unaided eye is the greatest objection to the use of telescope sights. It must be admitted, however, that with the target once in the field, the process of sighting the gun will be very much facilitated. No judgment is required; no fine eyesight; the gun is simply moved until the image of the target coincides with the cross-wires. It is held by many that the firing will be less rapid with these sights than with the ordinary bar sights, although others who have given the matter careful thought contend that it will not. When we consider that the element of *doubt* is totally removed, perhaps the latter are correct. At any rate we must always remember that our object is *to hit*, and not merely to get shots overboard, and if we make five hits out of five shots it is much better than making five hits out of seven shots in the same time.

In damp or misty weather the telescope is nearly useless. To provide against this, each one is fitted with a pair of finder sights. These are exact reproductions of the heads of the front and

rear bar sights now in use, and are secured to the top of the telescope with their line of sight parallel to the optical axis. They are but 13".7 apart, which is less than half the distance that is customarily allowed between sights; they should never be used except in the above case, or when it is desired to pick up the target in rough weather preparatory to the finer sighting with the telescope.

If a piece of paper is held at the point at which the pupil of the eye is placed in sighting through one of these telescopes, a bright spot is shown on the paper about 0.2 inch in diameter, which is just about the diameter of the normal pupil. If any portion of the pupil is coincident with the bright spot, the image of the cross-wires and target are seen. A movement of the eye throughout the whole coincidence of the bright spot and the pupil does not disturb the relative position of the two images, provided the cross-wires have been properly placed. It is apparent, then, that the head can be moved through nearly 0.4 inch without interfering with the sighting, while with the bar sights the eye must be kept in line with the target, front and rear sights. This constitutes an appreciable advantage that lies with the telescope sight.

Adjustment.

There is but one adjustment to be made with these sights, and that is to get the optical axis of the telescope parallel with the axis of the gun when the pointer is at zero.

It cannot now be stated how often this adjustment will be necessary. It will depend largely on the care that is taken in handling and cleaning the instrument and its operating mechanism.

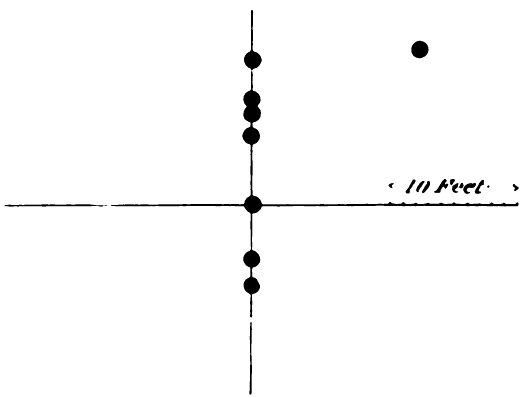
The parallel motion between the telescope and gun is assured if the distance between the center of the trunnions on the slide and the cross-shaft remains the same. Small variations in these distances caused by the racking of the turret will not affect the parallelism sensibly, although it will be necessary to readjust the telescope in such case. Recently at Indian Head an experimental 13-inch turret was struck by two shots from a 12-inch gun and one from a 10-inch gun without causing any apparent racking of the structure. There is, therefore, little ground for the fear that the sighting mechanism would be injured in battle from this cause.

The simplest way of restoring the gun and telescope to parallelism is by sighting through bore sights at some distant object, setting the drum to the zero reading, and adjusting the telescope so that the cross-wires cover the same object. A distance of not less than 2000 yards should be selected, if possible, in order to make the parallax inconsiderable.

In case the ship is not steady enough to use this method, fixed objects on board may be used. The gun should be leveled or brought to some other datum point, the telescope set to zero, and the distance between gun and telescope allowed for in the arrangement of the points to be sighted at. It is proposed to furnish an appliance by which this adjustment may be made simply and quickly.

So far as the meager returns tell us, these sights give good promise of greatly improving our gun practice.

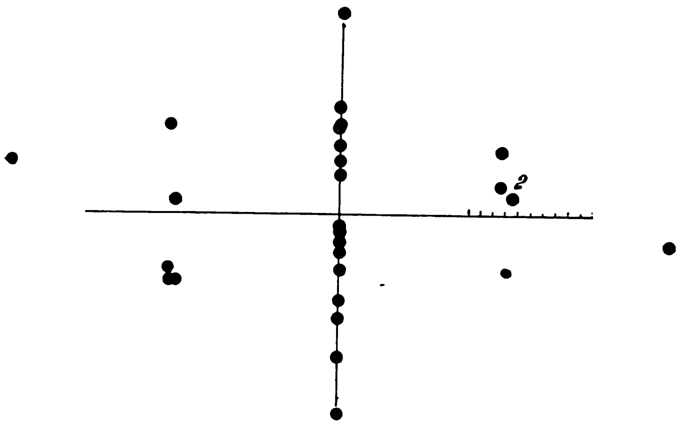
In the 8-inch and 13-inch scores shown below the ship was rolling five degrees and pitching three degrees. The time be-



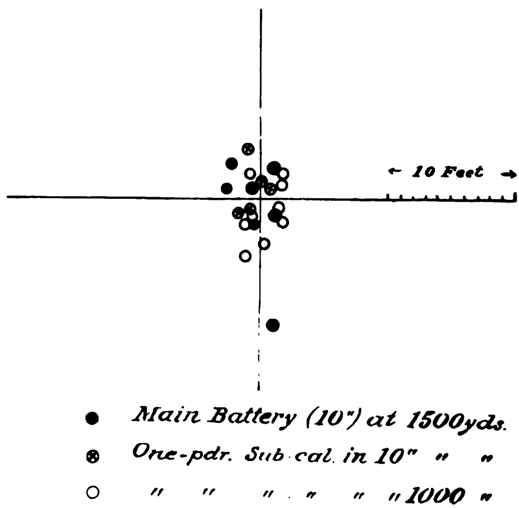
13-inch, 1000 yds. 8 Shots fired.

tween shots was less than has been attained heretofore with bar sights. In the 10-inch the time between shots was 2 min. 25 sec., which is about equal to that attained with bar sights, but the score is much the best that has hitherto been handed in with guns of that caliber. All of the scores are on vertical targets, with the size of the heavy shots drawn to scale.

Objection has been made to these sights on account of the care with which they must be handled. They are not as delicate as the sextant or the chronometer, and yet we consider these



8-inch, 1000 yds. 36 Shots fired.



instruments indispensable to the ship and take the greatest pains that they shall fulfil their object. Every effort has been made to give the mounting the strength and simplicity that ship

conditions call for, and yet it must be confessed that this makes another addition to the numerous delicate instruments now to be found on a modern man-of-war. But if we remember the prime cause for which the ship is built—a fact too often forgotten—and that is, to carry guns capable of striking blows at the enemy, we should not stop at any care or pains in providing the final link in the long chain that we have constructed to that end.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NOTES ON THE LITERATURE OF EXPLOSIVES.*

BY CHARLES E. MUNROE.

No. XXVII.

The "19th Annual Report of H. M. Inspector of Explosives" for the year 1894 states that blasting amberite, cordite, collodion cotton, Westfalite and Von Forster's powder were added to the list of authorized explosives; securite, compressed securite and Denaby powder were dropped from the list, as their manufacture was given up during the year. Nitro paper, plastomentite, electronite, granulite, normal smokeless powder, one variety of Rosslyn smokeless powder, emerald powder, carbonite, smokeless powder and Coopal's powder successfully passed Dr. Dupré's tests and were favorably reported on. Britianite passed the preliminary tests. Schnebelite, three varieties of Rosslyn smokeless powder and one of electronite failed and were rejected.

Schnebelite offers another example of the eventual rejection of a chlorate powder, the powder having passed successfully the preliminary trials as reported December 13th, 1893. During the succeeding year it was submitted to a more prolonged and searching examination, in the course of which, like other chlorate mixtures before tested, it developed certain features pointing to danger. Not only did it show a marked increase in sensibility to percussion and friction, but an appreciable portion of the chlorate became reduced to chloride.

* As it is proposed to continue these notes from time to time, authors, publishers, and manufacturers will do the writer a favor by sending him copies of their papers, publications or trade circulars. Address, *Columbian University, Washington, D. C.*

The sample of electronite which failed showed the peculiar behavior of ammonium salts. This sample consisted of amberite No. 1 (nitro-cellulose, nitro-glycerin, paraffin and shellac) mixed with a considerable proportion of ammonium carbonate, and it suffered serious decomposition, even when kept at ordinary temperature.

An invention having for its object the prevention of the mercury fulminate from escaping from detonators, and which consists either in covering the fulminate with a solid disk of celluloid which fits tightly in the case, or in coating the fulminate with collodion, was reported upon favorably, as was an invention consisting in the introduction of glass tubes filled with a strong solution of ammonia into gunpowder blasting cartridges, with a view to diminishing the effect of the flame produced on firing them.

With the admission of collodion cotton to the "authorized list," a revision in the definition of terms has been made. Hence *officially* collodion cotton consists "of thoroughly purified nitro-cotton (*a*) of which not less than 15 per cent. is soluble in ether-alcohol, and (*b*) which contains not more than 12.3 per cent. of nitrogen," while gun-cotton consists "of thoroughly purified nitro-cotton (*a*) of which not more than 15 per cent. is soluble in ether-alcohol, or (*b*) which contains more than 12.3 per cent. of nitrogen; and with or without carbonate of calcium." The term nitro-cotton is to be "substituted for nitro-cellulose in the definitions of ballistite, gelatine dynamite, blasting gelatine," etc. It is to be regretted that strictly scientific terms were not adopted at the outset, since much confusion of ideas has resulted from the official classification.

Another new feature in designation is in the use ot the terms "percussion cap" and "detonator," as a consequence of the two similar accidents which occurred in the drumming of caps in the Royal Laboratory, Woolwich, on July 24th and August 20th. The drum in which the caps are cleaned is of sheet iron, 2 feet in diameter by 7 inches wide, and at the time of the explosion it was charged with 80,000 caps for the 0.303-in. ball cordite ammunition, each containing 0.4 grain of a composition consisting of mercury fulminate, 6 parts; potassium chlorate, 14 parts; antimony sulphide, 18 parts; powder, mealed, 1 part; sulphur, ground, 1 part; together with a quantity of clean sawdust. The drum,

which is turned by hand, had been revolving some three or four minutes when the explosion took place. The explosion partly blew out one side of the drum and scorched the rope mantlet which surrounds it to a height of 6 feet 6 inches, doing no further damage. About 20,000 caps were recovered unexploded. Experiments made to determine the liability of these caps to explode *en masse* showed that this would not occur unless the caps were raised to a high temperature or mixed with loose composition, but as an additional precaution the dividing line between percussion caps and detonators has been raised above that fixed in Annual Report, 1885, pp. 69, 117, and 1890, p. 53, so that now it is ordered that "a *percussion cap* to be one containing a charge not exceeding 0.5 grain of composition, or 0.6 grain of composition when the quantity of fulminate of mercury does not exceed one-fourth of such composition; in any other case the cap will rank as a *detonator*."

In order to identify individual cartridges of explosives, especially when stolen, the German and Belgium governments have recently required that each be marked and numbered. The ingenious method devised by Germany, through which is indicated the factory of origin, date of manufacture, and case in which packed, is described in this report at length with diagrams. After consultation with English manufacturers it was decided that in view of the expense and inconvenience the system entails, and the facility with which the elaborate and costly precautions could apparently be defeated by evil-disposed persons, there was not sufficient warrant for directing the compulsory adoption of such a system.

The comments of Dr. Dupré on an accident at Gover Farm, Abergele, during the burning of rubbish in a grate, illustrates how numerous the causes are which may possibly give rise to explosions. He says: "I have carefully read the further information given, and have also inquired as to what kind of material farmers use that might possibly cause an explosion. I find that some kinds of manures are used consisting of a mixture of saltpeter and ground linseed, or similar cake. As a rule, no doubt, the saltpeter would not be present in sufficiently large proportion to produce an explosion, but it is quite possible that some sample of such manure may have accidentally been mixed with a larger proportion of niter than usual and thus have caused the accident.

It is also possible that the farmer intended to mix a small quantity of manure himself and bought the niter for the purpose."

The repeated spontaneous explosion of fireworks containing sulphur in admixture with potassium chlorate or other chlorate has led to the issuing of an Order in Council prohibiting the manufacture, importation, storage, conveyance or sale of such fireworks. An explosion of some colored lights at Hatton Garden, June 16, appears to have been due to the simple contact of the mixture of barium chlorate and shellac with the gunpowder in the quick-match. Notwithstanding they had been exposed, between two and three years, against the south wall to all weathers, they suddenly took fire. The case bears a strong resemblance to that occurring in the ignition of some green lances at Messrs. Pain's factory, in 1890, and which was clearly shown to be due to the contact of a composition containing barium chlorate with one containing sulphur.*

In recording with their usual fullness the foreign explosions of the year, considerable space is given to the accidents occurring in the United States on *July 4th*, which closes with the following amusing remark, "'Thanksgiving Day' therefore appears to have proved more than usually costly in 1894."

The importation of foreign nitro-glycerin compounds continues to decrease, it having fallen from 1,325,950 lbs. in 1889, the highest mark reached, to 539,802.5 lbs. in 1894, while the importation of detonators increased to 9,765,400 for the year. There were 290 tons of fireworks imported in 1894 against 190 tons in 1893.

It is to be noted that the samples of blasting gelatine tested failed to withstand the test as they should.

In *Dingler's Polyt. Jour.*, **284**, 137-143; 1892, O. Muhlhauser gives the result of his studies on the "Higher Nitric Ethers of Starch." After reviewing the history of the discovery and work done on nitro-starch, he says that it is only recently, by means of a process devised by the "Actiengesellschaft Dynamit Nobel," that it has been possible to manufacture it economically, and thus make it available as an explosive for military purposes. The product prepared by this process has the following composition: $C_6H_8O_3(NO_3)_2$.

* Rept. H. M. Insp. Exp., 1890, p. 35; Special Report No. 94.

The author succeeded in preparing two bodies of the composition $C_6H_{7\frac{1}{2}}$, $O_{2\frac{1}{2}}$, $(NO_2)_{2\frac{1}{2}}$, and $C_6H_7O_4(NO_2)_2$. The starch molecule must consequently be taken twice as large, viz. $C_{12}H_{20}O_{10}$, and the higher members regarded as—

		Per Cent. N.
Tetra-nitro-starch,	$C_{12}H_{16}O_6(ONO_2)_4$	11.11
Penta-nitro-starch,	$C_{12}H_{15}O_5(ONO_2)_5$	12.75
Hexa-nitro-starch,	$C_{12}H_{14}O_4(ONO_2)_6$	14.14

That no nitro-compounds, but true ethers (esters) of nitric acid are formed, is proved:

1st. In that the substances on treatment with sulphuric acid, separate NO_3H. The $O.NO_2$ residue appears thus to be replaced by the sulphuric acid residue.

2nd. On treatment with aqueous ferrous chloride, nitric oxide and soluble starch are regenerated.

3rd. On shaking with sulphuric acid over mercury all nitrogen is split off in the form of NO.

The body prepared by the process above referred to will be taken as tetra-nitro-starch.

This process is carried out as follows: Potato starch is dried at 100°, then ground and dissolved in nitric acid of 1.501 sp. gr. in a suitable vessel made of lead and provided with two jackets cooled by water. A screw agitator causes the acid to circulate. The starch is introduced through an opening in the cover of the combined agitator and digestor in the proportion of 10 kilos of starch to 100 kilos of acid, the temperature being maintained between 20° and 25°.

This solution is then led to a precipitating apparatus, which is also surrounded with a cooling jacket and provided with a double perforated bottom, between which is placed gun-cotton to act as a filter. This vessel is filled with spent nitro-sulphuric acid from the nitro-glycerin manufacture, and the solution of starch in nitric acid is sprayed into it through an ejector worked by compressed air, whereby the nitro-starch is precipitated in the form of a fine-grained powder. 500 kilos of spent nitro-sulphuric acid are required to precipitate 100 kilos of starch solution.

The nitro-starch collects on the gun-cotton filter, when the acid solution is run out and drained off through the tap at the bottom of the vessel and below the filter. It is then further freed from acid by pressure and washing till a neutral reaction is attained, and

afterwards it is treated and let stand for 24 hours in contact with 5 per cent. soda solution. The product is then ground until a " milk " is formed, which is filter-pressed and washed with water, and lastly treated with a solution of aniline, so that the pressed cake, which contains about 33 per cent. of water, shall contain 1 per cent. of aniline.

Nitro-starch prepared by the author on the same lines in the laboratory contained 10.96 and 11.09 per cent. of N. It is a snow-white powder, which becomes electrified on rubbing, and is very stable and soluble even in the cold, in nitro-glycerin.

The author also prepared a tetra-nitro-starch containing 10.58 and 10.50 per cent. of nitrogen by pouring into water a solution of starch in nitric acid, which had stood for several days. The body thus produced had all the properties of that prepared by the other process.

Penta-nitro-starch is produced along with some tetra-nitro-starch by adding 20 grms. of rice starch dried at 100 to a mixture of 100 grms. of nitric acid sp. gr. 1.501, and 300 grms. sulphuric acid sp. gr. 1.8. After standing for one hour the mass is discharged into a large quantity of water, and then washed with water and soda solution. The yield was 147.5 per cent. This body was heated with ether alcohol, then the ether was distilled off; the penta-nitro-starch thus became precipitated, the tetra-compound remaining dissolved in the alcohol. The portion insoluble in alcohol contained 12.76 and 12.98 per cent. of nitrogen, and was thus penta-nitro-starch. The other portion contained 10.45 of nitrogen.

Hexa-nitro-starch is the chief product when 40 grms. of dry starch are treated with 400 grms. of nitric acid, sp. gr. 1.501, and allowed to stand for 24 hours, and then 220 grms. of this solution are poured into 600 cc. of sulphuric acid of 66° B. The white powder thus produced contained 13.52, 13.23 and 13.22 per cent. of nitrogen, and therefore consisted principally of penta- and hexa-nitro-starch.

The experiments showed that the bodies prepared by precipitating the nitro-starch by strong sulphuric acid were less stable than those precipitated by water or weak sulphuric acid, the author being of opinion that possibly in the former case a sulpho-group may be formed, which in small quantity might occasion this instability. The following table shows the behavior of bodies prepared in different ways under various conditions.

	Ignition Point C.	Stability.	Per cent. N.	96 per cent. Alcohol.	Ether.	Ether-Alcohol.	Acetic Ether.
1 part nitric, 2 parts sulphuric acid (containing 70 per cent. of water)	175°	Stable.	11.02	Soluble.	Insoluble.	Soluble.	Soluble.
1 part nitric acid, water	170°	Stable.	10.54	Soluble.	Insoluble.	Soluble.	Soluble.
1 part nitric acid, 3 parts concentrated sulphuric acid	152°	Unstable.	12.87	Insoluble.	Insoluble.	Soluble.	Soluble.
1 part nitric acid, 3.5 parts concentrated sulphuric acid	121°	Unstable.	12.50	Insoluble.	Insoluble.	Soluble.	Soluble.
1 part nitric acid, 3 parts concentrated sulphuric acid	155°	Unstable.	13 52	Insoluble.	Insoluble.	Soluble.	Soluble.

The author recommends the production of a smokeless powder by moistening 6 grms. of nitro-jute and 2 grms. of nitro-starch with acetic ether, working into a uniform mixture, and then drying at 50°-56°. This product contained 11.54 per cent. of nitrogen and was very stable.

The *Jour. American Chemical Society*, **18**, 819-846; 1896, publishes under the title of "The Development of Smokeless Powders," the presidential address delivered by Charles E. Munroe, in which, after noting the various inventions and discoveries which made the production of a smokeless powder possible; the improvements in arms and appliances which made a smokeless powder essential; and the composition, properties and methods of manufacture of the various characteristic powders, he says:

"I began my own experiments with smokeless powder manufacture in 1889. At this time the remarkable results published from France and the announcement that that country had adopted a smokeless powder had produced their desired strategic effect. All her rivals were seeking to be equally well equipped, and were hastening to adopt a powder even before its qualities were thoroughly proven. The newspapers contained remarkable accounts of their performances and alleged descriptions of their methods of production which, while interesting as news and conveying valuable suggestions, could not be relied upon as to accuracy in details.

"At the outset, being familiar with the impossibility of securing absolute uniformity and constancy of composition in physical mixtures like gunpowder, and realizing how important this feature

was with our precise modern weapons and when employing an explosive possessing great energy, I determined to attempt to produce a powder which should consist of a single substance in a state of chemical purity. This was a thing which I had not known of having been done, nor have I yet learned that any one else has attempted it. Among the bodies at command the nitric ethers seemed most available, and of these cellulose nitrate seemed for many reasons the most promising.

"There are several of these nitrates (authorities differ as to the number) which differ in their action towards solvents, though all, except the most highly nitrated, are soluble in methyl alcohol. In the commercial production of cellulose nitrates certainly, and so far as I have observed under all circumstances, when nitrating cellulose, the product is a mixture of different cellulose nitrates. Even in the perfected Abel process for making military gun-cotton, as carried out at the Royal Gunpowder Factory at Waltham Abbey, according to Guttman, "Manufacture of Explosives," 2, 259; 1895, the product contains, as a rule, from 10 to 12 per cent. of nitro-cotton.

"Consequently I began by purifying my dried pulped military gun-cotton, which was done by extracting it with hot methyl alcohol in a continuous extractor, and when this was completed the insoluble cellulose nitrate was again exposed in the drying room. The highly nitrated cellulose was then mixed with a quantity of mono-nitro-benzene, which scarcely affected its appearance and did not alter its powdered form. The powder was then incorporated upon a grinder, by which it was colloidized and converted into a dark translucent mass resembling india rubber. The sheet was now stripped off and cut up into flat grains or strips, or it was pressed through a spaghetti machine and formed into cords, either solid or perforated, of the desired dimensions, which were cut into grains. Then the granulated explosive was immersed in water, boiling under the atmospheric pressure, by which the nitro-benzene was carried off and the cellulose nitrate was indurated so that the mass became light yellow to gray, and as dense and hard as ivory, and it was by this physical change in state, which could be varied within limits by the press, that I modified the material from a brisant rupturing explosive to a slow-burning propellent.

"This is the powder which I styled indurite, and which has been popularly known as the naval smokeless powder.

"I was satisfied that I was justified in starting on this new practice in powder-making when I found, on examination of the samples of foreign military powders which later began to reach me officially, that they were heterogeneous mixtures, as the old gunpowder is, and that they contained matter which was volatile at ordinary temperatures, and when I learned that the nitroglycerol powders cracked from freezing.

"I was still more satisfied when I learned the results of the proving tests which were all made, except the chemical, stability and breaking-down tests, by naval officers detailed for this purpose at the Proving Ground and elsewhere and who had no prejudice in its favor. All of the numerous publications which have appeared about it have issued from headquarters, and I present the matter myself here for the first time.

"I have appended the data from these trials to this address, where on inspection it will be seen that, after development, the powder in use, in successive rounds, gave remarkably regular pressures and uniform velocities. I was informed by the Chief of the Bureau before the firing trials, recorded in the tables, began, that if I could produce a powder giving 2000 feet initial velocity and but fifteen tons pressure it would be a complete success. Inspection of the tables shows that this was more than realized, and that in two successive rounds in the six-inch rapid-fire gun, using twenty-six pounds of my powder and a 100-lb. projectile, the pressures were 13.96 and 13.93 tons and the velocities 2469 and 2456 feet per second respectively, while, according to the Report of the Secretary of the Navy, 1892, page 26, 'The powder manufactured for use in the six-inch rapid-fire guns was stored at Indian Head Proving Ground, through a period of six months, covering a hot summer, and at the end of the time showed no change in a firing test."

"On page 25 Secretary Tracy says: 'It became apparent to the Department early in this administration, that unless it was content to fall behind the standard of military and naval progress abroad in respect to powder, it must take some steps to develop and to provide for the manufacture in this country of the new smokeless powder, from which extraordinary results had been obtained in Europe. With this object, negotiations were at first attempted looking to the acquisition of the secret of its composition and manufacture. Finding itself unable to accomplish this, the De-

partment turned its attention to the development of a similar product from independent investigation. The history of these investigations and of the successful work performed in this direction at the torpedo station has been recited in previous reports. It is a gratifying fact to be able to show that what we could not obtain through the assistance of others we succeeded in accomplishing ourselves, and that the results are considerably in advance of those hitherto attained in foreign countries.'

"From this survey we see that all the smokeless powders that have met with acceptance and proved of value as ballistic agents, with the exception of Indurite, are mixtures of one or more of the cellulose nitrates, or mixtures of these bodies with nitro-glycerin or some other oxidizing agent, like barium nitrate, and a restrainer or with a nitro-substitution compound, and that all have been condensed or hardened into a rubber-like or celluloid-like form, by which, even under the high pressures which obtain in the gun, they are expected to undergo combustion only, and that at a moderate and regular rate.

"In thus condensing the material and in determining the best form of grain, it will be observed that we have been guided by the experience gained in the compression of gunpowder, and we have been able to effect this as we have by the experience gained in the development of celluloid, and we have been able to manipulate our product and shape it into grains only by adopting the methods and machines developed in the manufacture of food, while we have been able to test our product and check our results, and thus ensure a more rapid and certain advance by the constant use of the pressure gauge and velocimeter. In my opinion, if these resources had not been at command and available the smokeless powder industry would not yet exist.

"From what has been said it may properly be inferred that we seek in these new powders all the virtues of the old gunpowder with the addition that the new powder shall be smokeless, impart higher velocities while producing no greater pressures, and that less of it shall be required to do the work. These requirements may be summed up as follows:

"The conditions that a smokeless powder suitable for a propellent should fulfill are:

"1. That is shall be physically and chemically uniform in composition.

"2. That it shall be stable and permanent under the varying conditions of temperature and humidity incident to service storage and use for all time.

"3. That it shall be sufficiently rigid to resist deformation in transportation and handling.

"4. That it shall produce a higher or as high a velocity with as low a pressure as the service charge of black powder for a given piece.

"5. That it shall be incapable of undergoing a detonating explosion.

"6. That the products of its combustion shall be nearly, if not quite, gaseous, so that there shall be no residue from it and little or no smoke.

"7. That it shall produce no noxious or irrespirable gases or vapors.

"8. That it shall not unduly erode the piece by developing an excessive temperature.

"9. That it shall be as safe as gunpowder in handling and loading.

"10. That it shall be no more than ordinarily dangerous to manufacture.

"Most of these requirements have been satisfied in several of the powders, but time alone can determine the question of absolute stability, and especially as the comparison is instituted with gunpowder, which has been under observation for over 500 years.

"We can and do apply tests whose results give us some confidence, as I did when I exposed indurite wrapped in felt in an iron vessel to a temperature of 208° F. for six hours without its undergoing change, and again at a temperature of 212° F. for twenty hours before any signs of change were observed, and again to 5° F. without its being affected.

"In fact, from the outset I have advised the most rigid tests being applied, and drew up the following scheme for the Navy Department in July, 1891, by which to test indurite:

"The most important requisite of powder, after passing the proof test, is that it shall retain its characteristics under all the conditions of storage or transportation which may obtain in the service, or that, if any change does take place, it shall not cause the powder to develop under the 'proof' conditions any greater pressure than it did at the time of proving, and that such falling

off in velocity as may result from this change in the powder shall not be relatively greater than that which obtains for service black powder, and shall be uniform for the same conditions of exposure.

"In providing for this test I would first prove a ten-pound lot to determine the maximum weight that will come within the limits fixed for pressure and velocity, and then I would load 1000 Winchester 30.1 cal. and 1000 Mannlicher shell with a charge some grains (say five) less than the maximum, so as to be doubly safe in case the pressure should become increased through the treatment to which the powder is subjected.

"The loading should be done with extreme care by skilled workmen in an especially clean and uniformly heated and dried room. The charges should be weighed on chemical balances and with all the precautions surrounding an analytical operation. The balls should be weighed and gauged, and the shell should be gauged so as to secure as nearly absolute uniformity as possible, while the caps and priming (if used) and wads should be identical for each shell of each 1000 lot.

"These being prepared, I would pack these ball cartridges precisely as if ready for issue to the service, and then I would store 385 Winchesters and 385 Mannlichers in the regular magazine at the Naval Torpedo Station, and the same number of the same kind in the regular magazine at the Naval Ordnance Proving Ground. I would then draw from the magazine at the Torpedo Station twenty-five Winchesters and twenty-five Mannlichers and fire them, using the muskets and measuring instruments which are to be used throughout the trials, and I would repeat this trial every month for three years, firing ten rounds of each form of ammunition and using the same muskets and instruments throughout. At the same time I would have an identical set of tests made at the proving ground, the same precautions being taken there regarding the instruments and tools. Throughout the tests a close watch should be kept on the magazine by means of maximum and minimum thermometers, so that if abnormal results are obtained in firing it may be known whether or not any abnormal conditions have obtained in the magazine. This series of tests will consume 1540 rounds. It would, in my judgment, be of much value to store with these cartridges and fire with them an equal number of charges of standard service black powder, to be used as a standard for reference by which

any error in the observations or defects in the instruments may be detected.

"I would take eighty rounds of the Winchesters and eighty of the Mannlichers and place them in an oven heated to 140° F. or thereabouts. At the end of one month twenty of each are to be drawn out, and this to be repeated each month for four months. One-half of each form should be proved at the Torpedo Station and the other half at the proving ground.

"I would take eighty rounds of the Winchesters and eighty of the Mannlichers and subject them for two weeks to the freezing temperature, then for two weeks to a temperature of about 140° F., and then draw twenty of each, and this should be continued until the last forty drawn out have been exposed for eight weeks to freezing and eight weeks to the high temperature. The firing trials with these should be made as with preceding ones.

"The remaining shell should be stored in the regular magazine, to be used in any test case which may arise or in any manner suggested by the results obtained in the tests described above.

"In the meantime tests could be made with the hand-cut S. P. for the capacity of the powder to resist crumbling and dusting during transportation, and the tendency of the fixed ammunition to explode *en masse* by the impact of projectiles or by the explosion of a single cartridge in the midst of a box filled with them. The first can be effected by taking a pound or a kilogram of carefully sifted powder, placing in a copper vessel which it only partly fills, and attaching it to a shaft so that it will be continually and violently shaken, and allowing this to go on every working day for a week. The powder can then be sifted, using the same mesh as before, the weight of the dust found and the percentage of dusting for the given circumstances determined.

"In the trials for tendency to explode *en masse* fifty or forty-five caliber ammunition can be used, and the weights of charges need not be very precise, but the ammunition should be packed in, as nearly as possible, the same way as would obtain in service practice.

"We have seen that the development of smokeless powder has been rendered necessary by the improvement in the gun. It now appears that in consequence of the possession of the powder we must further improve the gun, for we cannot in our present guns utilize all the energy now available. Experiments looking to

this have been going on in France, where in a Canet 10-cm. gun of 80 calibers, with a charge of 12.35 pounds of powder and a projectile weighing 28.66 pounds, there was obtained the extraordinary muzzle velocity of 3366 feet per second, while the maximum pressure was 18.91 tons per square inch. Longridge, an English authority, deprecates the lengthening of the gun, as it becomes too unwieldy, and he advocates utilizing the energy by strengthening the gun so it will endure greater pressures and then using larger charges. He points out that if this Canet gun were reduced to 45 calibers and strengthened we could obtain from it the same enormous muzzle velocity by increasing the charge to 13½ pounds, though the pressure would rise to 25 tons per square inch.

"What the result will be where authorities of standing disagree is impossible to foresee, but the fact is demonstrated that the powder is now more highly developed than the gun, and that while seeking for smokelessness, we have secured a propellent which is capable of producing much higher velocities than gunpowder, with all the additional advantages of flat trajectory, increased danger area, greater accuracy and greater range, which follow as consequences."

Messrs. William Macnab and E. Ristori have carried out a long series of experiments with explosive compounds for the purpose of studying chemical reactions at high temperatures and pressures, and of elucidating certain thermal constants relating chiefly to the specific heat of gases under such conditions, and a portion of their results is published in the *Proc. Roy. Soc.*, **56**, 8-19; 1894, under the title of "Researches on Modern Explosives."

For these experiments they have principally used nitro-glycerin, nitro-cellulose, and several combinations of these two bodies which are used for smokeless gunpowders, for the reason that such modern explosives offer the advantage of not only presenting comparatively simple chemical reactions, owing to the absence of solid residue, but also of enabling considerable variations to be made in their composition so as to vary the proportions of the elements reacting.

In this preliminary communication they propose chiefly to indicate the results obtained in the measurement of the heat evolved by explosion and of the quantity and composition of the gases produced by this metamorphosis.

They have also made considerable progress towards the determination of the actual temperature of explosion, and have succeeded in recording these high temperatures by photographic means, but these results are to be made the subject of another communication at an early date.

The great secret of all these modern explosives seems to be that by suitable means they are made into a solid substance, thus avoiding any porosity, and it appears probable that by doing so even the most powerful explosive can be mastered, so that, burning regularly from the surface, the rate of combustion can be controlled so as to avoid detonation.

This constitutes the most striking feature of the modern smokeless gunpowders, especially of those containing nitro-glycerin. If certain sized cubes, strips or cords of such powders are fired in a certain gun and the length of this gun does not allow of sufficient time during the travel of the shot for the explosive to be entirely consumed, the unburnt residue of the charge will be found to be of the same shape, whether cubes, strips or cords, only reduced in size; thus proving the most perfect surface combustion of these explosives.

It is thus possible to determine accurately what quantity of explosive, and what surface of combustion for the same, will be required, in order to obtain certain results in a certain gun, thus avoiding waste of powder.

The insensitiveness of modern smokeless powder was illustrated on the occasion of a disastrous fire which occurred in May, 1890, at the factory of Avigliana, Italy, where large quantities of ballistite were manufactured. In one building twelve tons of this explosive were collected and various operations of manufacture were performed. By accident some of it took fire, and the whole quantity was burnt in a few seconds. Though this powder was made of nitro-glycerin and nitro-cellulose, and though the amount was so large that had it been black powder it would have caused destruction for many miles around, still there was no explosion of any kind; none of the machinery was in any way damaged, and the wood was barely charred.

The explosives used in these experiments can be divided into three classes:

1. Those consisting of nitro-lignin or nitro-cellulose (not gelatinized) mixed or impregnated with a suitable nitrate, and mixed

with coloring matters and some other substances for the purpose of retarding the rate of combustion.

2. Those consisting of purified nitro-lignin or nitro-cellulose gelatinized by a suitable process, and with or without the addition of nitro-benzene or other suitable nitrates.

3. Those consisting of nitro-cellulose combined with nitro-glycerin, with the addition of aniline, camphor, vaseline, or other kindred substances.

The experiments were carried out in two closed vessels of different dimensions and construction—a large one capable of standing high pressures and a small one for calorimetric work.

The large one consists of a steel cylinder of great thickness, closed at both ends by conical screw-plugs. One plug is provided with a crusher-gauge of the well known pattern, by which the compression of a small cylinder of copper serves to measure the pressure developed. The other plug is provided with an insulated conical core, by means of which an electric current can be passed for the purpose of firing the charge. A small hole on the side of the cylinder, bushed with iridium-platinum and closed by a coned screw-plug, serves to control the escape of the gases produced by the explosion. The capacity of the chamber was carefully measured and was found to be 247.6 cc.

The small vessel is of the same pattern as used by Berthelot, and was made by Golaz, of Paris. It has given great satisfaction and is in excellent order, although it has been used for more than two hundred explosions. This bomb, which is made of mild steel and is cylindrical in shape, consists essentially of three parts—a bowl; a conical lid, which is accurately ground into the bowl; and a tightening cap, which screws on to the bowl over the lid. There is a small hole in the lid provided with a delivery tube, which can be opened and closed by means of a finely threaded conical plug. There is also an insulated platinum cone inserted from underneath in the lid, which admits of the charge in the bomb being fired by a platinum wire heated to redness by electricity. From the lid depend platinum supports which carry a platinum capsule, in which the explosive is placed and suspended in the middle of the chamber. The capacity of this bomb is 488 cc., and the total weight, including a small stand, when ready for immersion in the calorimeter, is 5633.28 grams.

The calorimeter is made of thin sheet brass, and a helicoidal

stirrer of the same metal (Berthelot's pattern), driven by a small electromotor during the experiment, serves to thoroughly mix the water. The calorimeter stood in the center of an annular water-jacket covered with felt. The quantity of water used in the calorimeter each time was 2500 grams, and the equivalent in water of the bomb, stirrer and calorimeter, due allowance having been made for the different specific heats of the different metals, is 623.4 grams.

The different thermometers employed were specially made by Casella, capable of being read to 0.005 of a degree centigrade, and the weights of their stems, bulbs and mercury were known.

Various experiments were made in the large vessel, especially for the purpose of determining the pressure of the gases under different densities of charge. These trials were carried out in a field, the bomb being lowered into a hole in the ground before firing. Various difficulties were encountered, and in one experiment considerable damage was done by the heated gases effecting their escape at the moment of explosion and "washing away" part of the thread of one of the screw-plugs.

With the density of loading of $\Delta = 0.1$, *i. e.*, with a charge of 24.76 grams, the average of the pressures measured was 6.3 tons per square inch; with density $\Delta = 0.2$ the pressure rose to 15 tons, and with $\Delta = 0.3$ the pressure increased to 25 tons. These results are very similar to those published by Sir A. Noble, F.R.S.

With the small bomb were ascertained the amount of heat generated by the explosion, the volume and composition of the permanent gases resulting, and the quantity of aqueous vapor produced. As most of the explosives contained no mineral matter beyond a trifling percentage of "ash," it has been possible to analyze them in this way, the products of explosion when calculated from the analysis and volume of permanent gas and aqueous vapor agreeing closely with the weight of matter in the bomb before firing. A few of the explosives left a carbonaceous or mineral residue, but these will be specially noticed further on in connection with the table of the results.

The heat evolved was measured by placing the bomb containing the charge of explosive in the calorimeter containing 2500 grams of water, and it was arranged that the temperature of the air, the water-jacket, and the calorimeter closely approximated each other. The stirrer was set in motion, and the thermometer

in the calorimeter was read with a kathetometer. Observations of the temperatures were made every minute for the five minutes preceding the firing of the charge, and continued at intervals of a minute until the maximum was reached and for five minutes longer. The correction for loss of heat due to radiation of heat during the experiments amounted in general to about 0.01 of a degree. The increase in temperature varied from about 1° to 2½° C., according to the charge and explosive used.

The gas generated by the explosion was passed through weighed drying tubes connected with the valve on the lid of the vessel, and then collected and measured in a calibrated glass cylinder over mercury. The reading of the barometer and thermometer was noted, and the volume reduced to 0° C. and 760 mm.

The water was determined by immersing the bomb in a vessel containing boiling water. A three-way glass stop-cock intervened between the valve of the bomb and the drying tubes, and the other end of the drying apparatus was connected with a water vacuum pump.

The other branch of the three-way tap was connected with a separate drying apparatus. When the water surrounding the bulb was boiling, by starting the vacuum pump the steam and water were drawn into the absorbing apparatus; after a good vacuum had been made in the bomb the three-way tap was turned so that dry air rushed in, then connection was made with the drying apparatus, the bomb again exhausted, and so on, alternately, until (as experience showed) all the water had been removed from the bomb and collected in the drying tubes, which were then weighed. The weights of water thus obtained were calculated for comparison into volumes of H_2O gas at 0° C. and 760 mm.

The analyses of gas were carried out in duplicate in Dittmar's apparatus as improved by Lennox.

In most of the experiments the bomb, previous to firing, was exhausted and the amount of residual pressure, varying from 24 to 40 mm., noted on closing it. The amount of air corresponding to these pressures left in the bomb has the effect of increasing the heat generated by a small quantity amounting to five to seven calories. This quantity being within the limits of error of the calorimetric observation, no correction was made for the same, but the quantity of residual air was taken into account when

comparing the weights of the products found with the weight of the explosive used. Thus in Tables I and II the volumes of gas of the given composition and of aqueous vapor were obtained from the given weight of explosive increased by the weight of the air corresponding to the vacuum indicated. When firing in an exhausted bomb it was found necessary to have the explosive surrounding the firing wire in comparatively small pieces, in order to ensure ignition of the whole charge.

TABLE I.—INDICATING THE QUANTITY OF HEAT, ALSO THE VOLUME AND ANALYSIS OF THE GAS DEVELOPED PER GRAM WITH DIFFERENT SPORTING AND MILITARY SMOKELESS POWDERS NOW IN USE.

Name of explosive.	Calories per gram.	Permanent gases.	Aqueous vapor.	Total volume of gas calculated at 0° and 760 mm.	Per cent. composition of permanent gases.					Coefficient of potential energy.
					CO_2.	CO.	CH_4.	H.	N.	
		Cc. per gram.	Cc. per gram.	Cc. per gram.						
EC powder, English	800	420	154	574	22.9	40.6	0.5	15.5	20.5	459
SS sporting powder, English	799	584	150	734	18.2	45.4	0.7	20.0	15.7	586
Troisdorf, German	943	700	195	895	18.7	47.9	0.8	17.4	15.2	844
Rifleite, English	864	766	159	925	14.2	50.1	0.3	20.5	14.9	799
BN, French	833	738	168	906	13.2	53.1	0.7	19.4	13.6	755
Cordite, English manufacture	1253	647	235	882	24.9	40.3	0.7	14.8	19.3	1105
Ballistite, German manufacture	1291	591	231	822	33.1	35.4	0.5	10.1	20.9	1061
Ballistite, Italian and Spanish manufacture	1317	581	245	826	35.9	32.6	0.3	9.0	22.2	1088

Table I gives the principal results obtained with the several gunpowders above mentioned, Tables II and III give the results obtained with samples of ballistite made with different proportions of the component parts, Table IV indicates the effect of firing different weights of the same explosive in a closed vessel from which the air has not been exhausted, and Table V gives the original elementary composition of several explosives compared with the products of combustion, both being represented as weights.

With the exception of the results given in Table IV, all the others were obtained from the firing of 4 grams of the explosive.

In Tables I and II we have expressed the results of firing some powders now in use, as well as certain specially prepared powders, so as to show the quantity of heat and the volumes and analyses of the gases produced, and have in the column headed "Coefficient of potential energy," given figures which serve as a measure of comparison of the power of the several explosives. These figures are the products of the number of calories by the volumes of gas, the last three figures being suppressed in order to simplify the results.

In the case of EC and SS a certain amount of mineral residue was left, but this was not determined.

TABLE II.—INDICATING THE QUANTITY OF HEAT, ALSO THE VOLUME AND ANALYSIS OF THE GAS DEVELOPED PER GRAM WITH NITRO-GLYCERIN, NITRO-CELLULOSE, AND WITH SEVERAL DIFFERENT COMBINATIONS OF THESE TWO EXPLOSIVES MADE AT ARDEER FACTORY.

	Composition of explosive.	Calories per gram.	Permanent gas.	Aqueous vapor.	Total volume of gas calculated at 0° and 760 mm.	Per cent. composition of permanent gases.						Coefficient of potential energy.
						CO_2.	CO.	CH_4.	O.	H.	N.	
			Cc. per gram.	Cc. per gram.	Cc. per gram.							
A.	Nitro-glycerin.	1652	464	257	741	63.0	..	..	4.0	..	33.0	1224
B.	Nitro-cellulose (nitrogen = 13.30 per cent.)	1061	673	203	876	22.3	45.4	0.5	..	14.9	16.9	929
C.	50 per cent. (nitro-cellulose (N=12.24 per cent.). 50 per cent. nitro-glycerin.	1349	568	249	817	36.5	32.5	0.2	..	8.4	22.4	1102
D.	50 per cent. (nitro-cellulose (N = 13.3 per cent.). 50 per cent. nitro-glycerin.	1410	550	247	797	41.8	27.5	..	..	6.0	24.7	1124
E.	80 per cent. nitro-cellulose (N=12.24 per cent.) 20 per cent. nitro-glycerin.	1062	675	226	901	21.7	45.4	0.1	..	15.7	17.1	957
F.	80 per cent. nitro-cellulose (N=13.30 per cent.). 20 per cent. nitro-glycerin.	1159	637	227	864	26.6	40.8	0.1	..	12.0	20.5	1001
G.	35 per cent. nitro-cellulose (N=13.30 per cent.). 5 per cent. vaseline. 60 per cent. nitro-glycerin.	1280	627	236	863	26.7	39.8	0.5	..	12.8	20.2	1105

TABLE III.—SHOWING THE HEAT DEVELOPED BY EXPLOSIVES CONTAINING NITRO-GLYCERIN AND NITRO-CELLULOSE IN DIFFERENT PROPORTIONS.

Composition of Explosives.			Calories per gram.
Nitro-cellulose (N = 13.3 per cent.).		Nitro-glycerin.	
100 per cent. (dry pulp).		0	1061
100 " " (gelatinized).		0	922
90 " "		10 per cent.	1044
80 " "		20 " "	1159
70 " "		30 " "	1267
60 " "		40 " "	1347
50 " "		50 " "	1410
40 " "		60 " "	1467
0 " "		100 " "	1652
Nitro-cellulose (N = 12.24 per cent.).		Nitro-glycerin.	
80 per cent.		20 per cent.	1062
60 " "		40 " "	1288
50 " "		50 " "	1349
40 " "		60 " "	1405
Nitro-cellulose (N = 13.3 per cent.)	Vaseline.	Nitro-glycerin.	
55 per cent.	5 per cent.	40 per cent.	1134
35 " "	5 " "	60 " "	1280

Troisdorf leaves a slight, and Rifleite and BN a considerable, carbonaceous residue, part of it adhering so tenaciously to the bomb that an exact determination was not made.

In the other experiments recorded in Tables I and II the degree of accuracy of the results may be gauged by the fact that the average weight of the products of explosion, calculated from the results found, amounts to 99.7 per cent. of the weight of the explosive fired, the extreme limits being 100.5 and 98.9 per cent.

In Table II the comparison of the pairs of results from explosives made with lower and more highly nitrated nitro-cellulose shows that the use of the highly nitrated cellulose increases the quantity of heat developed and diminishes the volume of gas. The composition of the permanent gases is also altered, as might be expected, there being an increase in carbon dioxide and decrease in carbon monoxide and hydrogen.

The similarity in the volumes of gas produced and the composition of the permanent gases in the case of experiments F and G is worthy of note when the great difference in the original component ingredients of the explosives is borne in mind.

Table III shows clearly the increase of heat due to increased percentage of nitro-glycerin, as well as the difference of heat evolved from explosives containing nitro-cellulose of different degrees of nitration.

The diminution in quantity of heat (about 200 calories) which the replacement of 5 per cent. of nitro-cellulose by vaseline makes is also very striking.

Table IV shows the part played by the oxygen of the air in the bomb; when a smaller proportion of explosive in comparison with the air is present the combustion is more complete, and the heat evolved is greater, and the composition of the gases is correspondingly modified.

TABLE IV.—SHOWING THE HEAT DEVELOPED AND THE ANALYSIS OF THE PERMANENT GAS PRODUCED IN A CLOSED VESSEL FROM WHICH THE AIR HAS NOT BEEN EXHAUSTED—THE EXPLOSIVE BEING IN EVERY CASE BALLISTITE OF ITALIAN MANUFACTURE.

Charge.	Calories per gram.	Analysis of the permanent gas.			
		CO_2.	CO.	H.	N.
2 grams	1587	37.0	17.6	3.2	42.2
3 "	1485	36.4	22.0	4.6	37.0
4 "	1446	36.2	24.6	6.1	33.1
5 "	1415	36.2	26.0	7.2	30.6
6 "	1380	36.3	27.0	7.9	28.6

Traces of CH_4 were found, but in this series of experiments the quantity of this gas was not determined.

Table V, the elementary composition of some of the explosives, along with the percentage composition of the products of explosion by weight, is given.

TABLE V.—SHOWING THE ORIGINAL COMPOSITION AND METAMORPHOSIS OF NITRO-CELLULOSE, NITRO-GLYCERIN, AND OF SEVERAL GUNPOWDERS MADE BY COMBINATIONS OF THESE TWO EXPLOSIVES.

Nature and description of explosives.	Per cent. composition by weight.				Per cent. products of combustion by weight.						
	Carbon, C.	Oxygen, O.	Hydrogen, H.	Nitrogen, N.	Carbonic acid, CO_2.	Carbonic oxide, CO.	Marsh gas, CH_4.	Oxygen, O.	Hydrogen, H.	Nitrogen, N.	Water, H_2O.
A. Nitro-glycerin.	15.7	63.0	2.3	18.8	57.6	..	..	2.7	..	18.8	20.7
B. Nitro-cellulose (nitrogen = 13.3).	24.58	57.68	2.73	13.6	29.27	38.52	0.24	..	0.86	13.6	16.30
C. 50 per cent. nitro-cellulose (N = 12.24 per cent.). 50 per cent. nitro-glycerin.	21.15	60.67	2.67	15.58	41.0	23.1	0.08	..	0.4	15.58	20.01
D. 50 per cent. nitro-cellulose (N=13.30 per cent.). 50 per cent. nitro-glycerin.	20.47	61.23	2.49	16.35	45.3	19.0	..	..	0.3	16.35	19.90
E. 80 per cent. nitro-cellulose (N=12.24 per cent.). 20 per cent. nitro-glycerin.	24.37	58.98	2.98	14.0	28.9	38.4	0.05	..	1.0	14.0	18.2
F. 80 per cent. nitro-cellulose (N=13.30 per cent.). 20 per cent. nitro-glycerin.	23.11	58.98	2.71	15.84	33.4	32.6	0.04	..	0.7	15.84	18.2
G. 35 per cent. nitro-cellulose (N=13.30 per cent.) 5 per cent. vaseline 60 per cent. nitro-glycerin.	22.2	59.0	2.88	15.46	33.0	31.3	0.2	..	0.7	15.46	19.0
H. Cordite, English manufacture.	22.91	57.72	2.95	15.19	31.76	32.68	0.32	..	0.86	15.19	18.08
K. Ballistite, Italian and Spanish manufacture.	21.47	60.83	2.68	15.80	41.11	23.76	0.12	..	0.47	15.8	19.69

The composition of the samples has been calculated from the "bomb" analyses; as an example, one of the explosives and its decomposition may be represented approximately by the following equation.

They have assumed the nitro-cellulose to consist of a mixture of di- and tri-nitro-cellulose in proportion corresponding to the nitrogen as found by analysis.

The equation for experiment C may be taken as follows:

$$\underbrace{6\,[C_3H_5\,(NO_3)_3]}_{\text{50 per cent. nitro-glycerin.}} + \underbrace{2\,[C_6H_7\,(NO_3)_3O_2] + 3\,[C_6H_8\,(NO_3)_2O_3]}_{\text{50 per cent. nitro-cellulose (N=12.3 per cent.).}} = 25CO_2 + 23CO + 8H + 30N + 30H_2O.$$

The composition of this explosive, calculated from the foregoing formula and found by analysis, is as follows:

	FORMULA.	ANALYSIS.
C	21.2	21.15
O	60.8	60.67
H	2.5	2.67
N	15.5	15.58
	100.0	100.07

These are some of the principal features noticeable in a preliminary survey of these experiments. They are continuing their investigations on the lines indicated in the paper, and are especially endeavoring to measure the actual temperature of explosion under varying conditions, and it is hoped that the result obtained will throw some light on the chemical and physical properties of many gases at high temperatures and under considerable pressures, and, at the same time, be useful in the practical application of explosives.

The "Researches on Explosives," on which Capt. A. Noble and Sir F. Abel have been engaged for very many years, have had their scope so altered and extended by the rapid advances which have been made in the science of explosives that they have been unable to lay before the Society the results of the many hundreds of experiments carried out under varied conditions. They have been desirous of clearing up some difficulties which have presented themselves with certain modern explosives when dealing with high densities and pressures, but the necessary investigations have occupied so much time that Capt. Noble has issued a preliminary note in the *Proceedings Royal Society*, **56**, **205-221**; 1894, trusting before long to be able to submit a more complete memoir.

A portion of their reasearches includes investigations into the transformation and ballistic properties of powders varying greatly

in composition, but of which potassium nitrate is the chief constituent. In this preliminary note it is proposed to refer to powders of this description chiefly for purposes of comparison, and to devote attention principally to gun-cotton and to those modern explosives of which gun-cotton forms a principal ingredient.

In determining the transformation experienced during explosion, the same arrangements for firing the explosive and collecting the gases were followed as are described in their earlier researches,* and the gases themselves were, after being sealed, analyzed either under the personal superintendence of Sir F. Abel or of Prof. Dewar.

The heat developed by explosion and the quantity of permanent gases generated were also determined, as described in their researches, but the amount of water formed plays so important a part in the transformation that special means were adopted in order to obtain this product with exactness.

The arrangement employed was as follows: After the explosion the gases formed were allowed to escape through two U tubes filled with pumice stone and concentrated sulphuric acid; when the gases had all escaped the explosion cylinder was opened and the water deposited at the bottom of the cylinder was collected in a sponge, placed in a closed glass vessel and weighed. The cylinder was then nearly closed and heated, and a measured quantity of air was, by means of an aspirator, drawn slowly through the U tubes till the cylinder was perfectly dry. This was easily ascertained by observing when moisture was no longer deposited on a cooled glass tube through which the air passed.

The U tubes were then carefully weighed, the amount of moisture absorbed determined and added to the quantity of water directly collected. The aqueous vapor in the air employed for drying was, for each experiment, determined and deducted from the gross amount.

Numerous experiments were made to ascertain the relation of the tension of the various explosives employed, to the gravimetric density of the charge when fired in a close vessel, but this subject is too large to be treated of in a preliminary note, and besides

*Phil. Trans., 165, 61.

approximate values have already been published* for several of the explosives with which they have experimented.

With certain explosives the possibility or probability of detonation was very carefully investigated. In some cases the explosive was merely placed in the explosion vessel in close proximity to a charge of mercuric fulminate, by which it was fired, but the most satisfactory method was to place the charge in a small shell packed as tightly as possible, the shell then being placed in a large explosion vessel and fired by means of mercuric fulminate. The tension in the small shell at the moment of fracture and the tension in the large explosion vessel were in each experiment carefully measured.

Capt. Noble does not consider the presence of a high pressure with any explosive as necessarily denoting detonation. Both cordite and gun-cotton have developed enormous pressures, close upon 100 tons per square inch (about 15,000 atmospheres), but he has not succeeded in detonating the former explosive, while gun-cotton can be detonated with the utmost ease. It is obvious that if we suppose a small charge fired in a vessel impervious to heat, the rapidity or slowness of combustion will make no difference in the developed pressure, and that pressure will be the highest of which the explosive is capable, regard being of course had to the density of the charge. A small charge is supposed, because if a large charge were in question and explosion took place with extreme rapidity, the nascent gases may give rise to such whirlwinds of pressure that any means we may have of registering the tension will show pressures very much higher than would be registered were the gases, at the same temperature, in a state of quiescence. Innumerable proofs have been had of this action, but it is evident that in a very small charge the nascent gases will have much less energy than in the case of a large charge occupying a considerable space.

The great increase in the magnitude of the charges fired from modern guns has rendered the question of erosion one of great importance. Few, who have not had actual experience, have any idea how rapidly with very large charges the surface of the bore is removed. Great attention has therefore been paid to this point, both in regard to the erosive power of different explosives and in

* Noble, *Internal Ballistics*, 33; 1892, and *Proc. Roy. Soc.*, 52, 128.

regard to the capacity of different materials (chiefly different natures of steel) to resist the erosive action. The method adopted consisted in allowing large charges to escape through a small vent. The amount of the metal removed by the passage of the products of explosion, which amount was determined by calibration, was taken as a measure of the erosive power of the explosive.

Experiments were also made to determine the rate at which the products of explosion part with their heat to the surrounding envelope, the products of explosion being altogether confined.

Turning now to ballistic results, the energies which the new explosives are capable of developing, and the high pressures at which the resulting gases are discharged from the muzzle of the gun, render length of bore of increased importance. With the object of ascertaining with more precision the advantages to be gained by length, the firm to which Captain Noble belongs has experimented with a 6-inch gun of 100 calibers in length. In these experiments the velocity and energy generated has not only been measured at the muzzle, but the velocity and the pressure producing this velocity have been obtained for every point of the bore, consequently the loss of velocity and energy due to any particular shortening of the bore can be at once deduced. These results have been obtained by measuring the velocities every round at sixteen points in the bore and at the muzzle. These data enable a velocity curve to be laid down, while from this curve the corresponding pressure curve can be calculated. The maximum chamber pressure obtained by these means is corroborated by simultaneous observations taken with crusher gauges, and the internal ballistics of various explosives have thus been completely determined.

Commencing with gun-cotton, with which a very large number of analyses were made, with the view of determining whether there was any material difference in the decomposition dependent upon the pressure under which it was exploded, two descriptions were employed: one in the form of hank or strand, and the other in the form of compressed pellets. Both natures were approximately of the same composition, of Waltham Abbey manufacture, containing in a dried sample about 4.4 per cent. of soluble cotton and 95.6 per cent. of insoluble. As used, it contained about 2.25 per cent. of moisture.

The following were the results of the analyses of the permanent gases. They are placed in five series, viz.: First, analyses show-

ing the decomposition of the strand or hank gun-cotton; second, analyses showing the decomposition of pellet gun-cotton; third and fourth, examples of the decomposition of strand and pellet gun-cotton when exploded by means of mercuric fulminate; and fifth, a series showing the decomposition experienced by pellet gun-cotton saturated with from 25 to 30 per cent. of water, and detonated by means of a primer of dry gun-cotton and mercuric fulminate.

In Tables I and II the marked manner in which the carbon dioxide increases with the pressure, and which has been heretofore noted for gunpowder, is again exhibited. It will be observed that in Table I the volumes of carbon dioxide and carbon monoxide are nearly exactly reversed; again, considering that the composition of the pellet and strand gun-cotton is practically the same, the distinct difference between the proportions of these products in the two series is sufficiently remarkable. It not improbably is connected with the rapidity of combustion of the two samples. Another striking peculiarity is the manner in which CO_2 is increased (as exhibited in Table V) when saturated pellet cotton is detonated.

I.—Results in Volumes of the Analyses of the Permanent Gases generated by the Explosion of Strand Gun-cotton, arranged according to Ascending Pressures.

Under pressure of gas.	Tons per square inch.										
	1.5	2.5	8.0	8.0	12.0	12.3	18.0	20.0	45.0?	48.0?	50.0?
CO_2 (vols.)...........	26.49	29.62	30.95	31.00	32.23	32.70	33.63	33.01	34.70	34.77	35.18
CO "	36.66	35.03	32.27	32.76	30 65	31.36	31 20	30.32	28.60	28.66	27 57
H "	19.68	17.13	19.10	18.80	20.38	19.23	17.99	18.25	16.56	17.48	16.76
N "	16.85	18.18	17.20	16.90	16.43	16.25	16.23	16.60	16.83	16.05	16.15
CH_4 "	0.32	0.04	0 48	0.54	0.31	0.46	0.95	1.82	3.31	3.04	3.34

II.—Similar Analyses of Pellet Gun-cotton.

Under pressure of gas.	Tons per square inch.									
	1.0	1.5	6.5	11.0	14.0	15.0	17.0	17.0	25.0	30.0
CO_2 (vols.).................	21.50	25 03	25.61	26.68	27.41	25.75	28.54	28.39	28.24	28.88
CO "	39.70	36.85	39.51	36.97	37.23	38.00	35.52	36.41	34 94	35.64
H "	22.83	21.00	18.80	19.59	19.37	19.71	18.47	19.64	20.30	20.50
N "	15.58	15.88	15.97	15.91	15.35	15.26	16.08	14.90	15.59	14.98
CH_4 "	0.39	1.24	0.11	0.85	0.64	1.28	1.39	0.66	0.93	

III.—RESULTS OF THE ANALYSES OF STRAND GUN-COTTON WHEN FIRED IN A CLOSE VESSEL BY DETONATION.

	Pressure* per sq. inch. 1 ton.	3 tons.
CO_2 (vols.)	19.21	29.08
CO "	41.25	32.88
H "	23.07	20.14
N "	16.21	17.50
CH_4 "	0.26	0.75

IV.—SIMILAR RESULTS FOR PELLET GUN-COTTON.

	Pressure per sq. inch. 3 tons.	10 tons.
CO_2 (vols.)	25.76	26.50
CO "	39.34	37.48
H "	18.71	20.97
N "	16.19	15.05
CH_4 "	nil	nil

V.—RESULTS OF ANALYSES OF SATURATED PELLET GUN-COTTON FIRED IN A CLOSE VESSEL BY DETONATION.

	Pressure per sq. inch. Under 10 tons.	10.5 tons.	16 tons.	16.5 tons.
CO_2 (vols.)	32.14	33.25	32.93	35.60
CO "	27.04	25.90	27.25	23.43
H "	26.80	26.53	25.76	24.22
N "	13.83	14.32	14.06	15.25
CH_4 "	0.19	nil	nil	1.50

Such are the average analyses of the permanent gases generated by the decomposition of gun-cotton under the various conditions described, and it will be evident from these analyses that the volumes of the permanent gases may be expected to differ to some very appreciable extent, depending both upon the density under which it is exploded and also upon the mode of explosion. He has found it most convenient to explode the charges, the permanent gases from which were to be measured, under a pressure of about 10 tons per square inch (1524 atmospheres), and, under these circumstances, the average of several very accordant determinations gave, at 0° C. and 760 mm. of mercury, 689 cc. per gram of strand gun-cotton and 725 cc. per gram of pellet gun-cotton.

* The pressures given are those due to the gravimetric density of the charge.

At the temperature of explosion the whole of the water formed is in the gaseous state. It is therefore necessary, in order to obtain the total gaseous volume, to add to the above volumes of permanent gases the equivalent volume of aqueous vapor at the temperature and pressure stated. Now the quantity of water formed by the explosion of 129.6 grams of gun-cotton was found to be 16.985 grams; hence 1 gram of gun-cotton generated 0.1311 gram of water, equivalent to 162.6 cc. of aqueous vapor, and the total volume of gaseous matter at the temperature and pressure stated is for strand gun-cotton 852.2 cc. per gram, for pellet 887.6 cc.

The heat measured reached, with strand gun-cotton, 1068 gram-units water fluid, or 988 gram-units water gaseous, while with pellet gun-cotton these figures were 1037 or 957 gram-units respectively. Pellet gun-cotton made at Stowmarket generated 738 cc. of permanent gas and 994 units of heat per gram, while dinitro-cellulose containing 12.8 per cent. of nitrogen generated 748 cc. of gas and 977 units of heat, the water in both cases being fluid.

Gun-cotton, both pellet and strand, were detonated by means of mercuric fulminate with ease and certainty. The effect of employing this means of ignition in a close vessel is very striking, and the indications of intense heat are much more apparent than when the charge is fired in the ordinary way. This effect is probably partly due to an actual higher temperature, caused by the greater rapidity of combustion. This extreme heat is clearly indicated by the surfaces of the internal crusher gauges becoming covered with innumerable small cracks and by thin laminæ occasionally flaking off exposed surfaces; but perhaps the most striking proof of the violence of this detonation is shown by its action on a cast-iron shell fired as described; where no detonation takes place the shell is broken into fragments of various sizes, such as are familiar to all acquainted with the bursting of shell; but when detonation, with gun-cotton for example, takes place the whole shell is reduced to very minute fragments, and, what is more remarkable, two-thirds of the total weight are generally in the form of small peas and of the finest dust.

The ease with which gun-cotton can be
unsuitable for use as a propulsive agent u
in some way neutralized. He has, then

experiments in this direction, and will not further allude to them in this note, as more suitable explosives, explosives also of which gun-cotton is a principal component, have been elaborated, and these not only possess to the full the high ballistic properties of gun-cotton, but are more or less free from the tendency to detonate, which, however useful it may be in other directions, is a fatal objection to the employment of gun-cotton for propelling purposes.

Turning now to cordite; cordite consists, as is well known, of nitro-glycerin and gun-cotton as its main ingredients. As now made it contains 37 per cent. of gun-cotton (trinitro-cellulose with a small proportion of soluble gun-cotton), 58 per cent. of nitro-glycerin, and 5 per cent. of vaselin. On account of the importance of this explosive, he has made numerous experiments, both with large and small charges, to determine the relation of the tension to the density of the charge. Up to densities of 0.55 the relation may be considered to be very approximately determined; above that density, although many determinations have been made, these determinations have shown such wide variations that they cannot, until certain discrepancies are explained, be assumed as at all accurate.

The average results of some of the analyses of the permanent gases are given below. The first four analyses were made from experiments with the earlier samples of cordite when tannin formed an ingredient of cordite. They are not, therefore, strictly comparable with the later analyses. There appears also to be a difference in the transformation, slight but decided, which the same cordite experiences, dependent upon the diameter of the cord, and this difference is shown at once in the analyses, in the volume of permanent gases, in the heat developed, and, I think, in the amount of aqueous vapor formed.

The following are some of the analyses:

TABLE VI.

	Pressure per square inch.							
	0.048 Cordite.				0.255 Cordite.			
	2.5 tons.	6 tons.	10 tons.	14 tons.	10 tons.	12 tons.	11 tons.	14 tons.
CO_2 ..	29.9	30.4	32.0	31.6	27.0	28.4	23.9	26.3
CO ...	28.3	30.7	32.9	32.1	34.2	33.8	37.2	35.8
H	19.3	20.0	18.0	21.6	26.9	24.4	28.4	26.1
N	22.5	18.9	17.1	14.8	12.0	13.4	10.4	11.8
CH_4				traces.				

In the whole of these analyses the water formed by the explosion smelt strongly of ammonia.

The quantity of permanent gases measured, under the same conditions as in the case of gun-cotton, was found to be, for the earlier cordite, 655 vols.; for the present service cordite, 0.255 in. in diameter, 692 vols., and for that 0.048 in. in diameter, 698 vols. In the two latter samples the aqueous vapor was determined, and was found to amount to 20.257 grams for the 0.255-in. cordite and to 20.126 grams for the 0.048-in. cordite; or, stating the result per gram, these figures are respectively equivalent to 0.1563 gram or 194 cc. aqueous vapor, and to 0.1553 gram or 192.5 cc. per gram of cordite. Hence the total gaseous products generated by the explosion of cordite amount per gram to 886 cc. for the 0.255-in. cordite and to 890.5 cc. for the 0.048-in. cordite, the volumes being of course taken at 0° C. and 760 mm. atmospheric pressure.

The heat generated was found to be: for the earlier cordite, 1214 gram-units water fluid; for the service 0.255-in. cordite, 1284 gram-units water fluid or 1189 units water gaseous; for the service 0.048-in. cordite, 1272 units water fluid or 1178 units water gaseous.

From his very numerous experiments on erosion he arrives at the conclusion that the principal factors determining its amount are: (1) the actual temperature of the products of combustion, (2) the motion of these products. But little erosive effect is produced, even by the most erosive powders, in close vessels, or in those portions of the chambers of guns where the motion of the gas is feeble or *nil*; but the case is widely different where there is rapid motion of the gases at high densities. It is not difficult absolutely to retain without leakage the products of explosions at very high pressures, but if there be any appreciable escape before the gases are cooled they instantly cut a way for themselves with astonishing rapidity, totally destroying the surfaces over or through which they pass. Among all the explosives with which I have experimented I have found that where the heat developed is low the erosive effect is also low.

The most erosive of ordinary powders is the brown prismatic powder, which, on account of other properties, is used for the battering charges of heavy guns. The erosive effect of cordite, if considered in relation to the energy generated by the two

explosives, is very slightly greater than that of brown prismatic, but very much higher effects can, if it be so desired, be obtained with cordite, and, if the highest energy be demanded, the erosion will be proportionately greater. There is, however, one curious and satisfactory peculiarity connected with erosion by cordite. Erosion produced by the ordinary gunpowder has the most singular effect on the metal of the gun, eating out large holes and forming long rough grooves, resembling a ploughed field in miniature, and these grooves have, moreover, the unpleasant habit of being very apt to develop cracks; but with cordite the erosion is of a very different character. The eddy holes and long grooves are absent, and the erosion appears to consist in a simple washing away of the surface of the steel barrel.

Cordite does not detonate; at least, although he has made far more experiments on detonation with this explosive than with any other, he has never succeeded in detonating it. With an explosive like cordite, capable of developing enormous pressures, it is of course easy, if the cordite be finely comminuted, to develop very high tensions, but a high pressure does not necessarily imply detonation.

The rapidity with which cordite gases lose their temperature, and consequently their pressure, by communication of their heat to their surrounding envelope is very striking. Exploding a charge of about 1¾ lbs. of cordite in a close vessel at a tension of a little over 6 tons on the square inch, or say 1000 atmospheres, he has found that the pressure of 6 tons per square inch was again reached in 0.07 sec. after explosion, of 5 tons in 0.171 sec., of 4 tons in 0.731 sec., of 3 tons in 1.764 secs., of 2 tons in 3.523 secs., and of 1 ton in 7.08 secs. The loss of pressure after 1 ton per square inch was reached was of course slow, but the figures given are closely approximated to in two subsequent experiments. With ordinary gunpowder the reduction of pressure was very much slower, as was to be expected, on account of the charge being much larger; on account, also, of the temperature of explosion being much lower. These experiments are now being continued with larger charges and higher pressures.

It only remains to give particulars as to ballistics, that is as to the velocities and energies realisable by cordite in the bore of a gun, but these will be most conveniently given with similar details regarding other explosives.

The ballistite used has, like cordite, been changed in composition since the commencement of the experiments. The sample used for his earlier experiments was nearly exactly composed of 50 per cent. of dinitro-cellulose (collodion cotton) and 50 per cent. of nitro-glycerin. The cubes were coated with graphite, and the nitro-cellulose was wholly soluble in ether-alcohol. The second sample was nominally composed of 60 per cent. of nitro-cellulose and 40 per cent. of nitro-glycerin. The proximate analysis gave—

Nitro-glycerin	41.62
Nitro-cellulose	59.05

and, as before, the whole of the nitro-cellulose was soluble in ether-alcohol.

The earlier sample gave the following permanent gases under pressures of six and twelve tons per square inch respectively:

CO_2	37.3	38.49
CO	27.8	28.35
H	19.1	19.83
N	15.8	13.32
CH_4		traces

One gram of this ballistite gives rise to 610 cc. of permanent gases, and to 0.1588 gram of aqueous vapor corresponding to 197 cc. at 0° C. and 760 mm.

Hence the total volume of gas is 807 cc., and the heat generated by the explosion is 1.365 gram-units (water fluid), 1.269 gram-units (water gaseous).

Although he has not made nearly so many experiments on detonation with ballistite as with cordite, those he has made with the earlier samples (50 per cent. gun-cotton and 50 per cent. nitro-glycerin) neither detonated nor showed any tendency to, but a sample of ballistite consisting of 60 per cent. gun-cotton and 40 per cent. nitro-glycerin, in 0.2-in. cubes, detonated with great violence on two occasions, though he is unable, without further experience, to say whether this result was due to the change in the composition of the ballistite or to defective manufacture.

The erosive action of ballistite is, as might perhaps be anticipated from the higher heat developed, greater than with cordite,

but the remarks made with respect to the action of cordite apply also to ballistite.

The French B. N. powder consists of nitro-cellulose partially gelatinized and mixed with tannin, with barium and potassium nitrates. When exploded under a pressure of six tons per square inch the permanent gases were found to consist of—

CO_2	28.1	vols.
CO	32.4	"
H	21.9	"
N	16.8	"
CH_4	0.8	"

These permanent gases occupied at the usual temperature and pressure a volume of 616 cc.; the aqueous vapor formed occupied in addition 206 cc., so that the total gaseous volume was 822 cc. The heat generated was 1003 gram-units (water fluid), or 902 gram-units (water gaseous); the ballistics obtained with this powder are given along with those furnished by other explosives.

The results of the firing trials are exhibited by three plates. Fig. 1 shows the velocities of seven different explosives from the commencement of motion to the muzzle of the gun; the position of the points at which the velocity is determined is shown, and on the lowest and highest curves the observed velocities are marked where it is possible to do so without confusing the diagram. Lines are drawn to indicate the velocities that are obtained with the lengths of 40, 50, 75, and 100 calibers.

Fig. 2 shows the pressures by which the velocities of Fig. 1 were obtained. The areas of these curves represent the energies realized, and the lines intersecting the curves indicate the pressures at which the gases are discharged from the muzzle for lengths of 40, 50, 75, and 100 calibers respectively. The chamber pressures indicated by crusher gauges are also shown in Fig. 2, and it is to be observed that the two modes of determining the maximum pressure are in general in close accordance. It will further be observed that with the slow-burning powders the chronoscopic maximum pressures are somewhat, though not greatly higher than are those indicated by the crusher gauges. This observation is not new.* It was noted in the long series of

* Noble and Abel, *Phil. Trans.*, 165, 110.

experiments with black powders carried on by the Committee of Explosives. The result is widely different where an explosive powder or a quickly-burning powder, such as R. L. G., giving rise to wave pressure is employed; the crusher gauge in such cases* gives considerably and frequently very greatly higher pressures, and this peculiarity is illustrated in the curve from R. L. G. in Fig. 2.

The results given in Fig. 1 have to be considered in relation to the facts disclosed in Fig. 2. Thus it will be noted that the velocities and energies realized by 22 lbs. of 0.35-in. cordite and 20 lbs. of 0.3-in. cordite are practically the same, but reference to Fig. 2 shows that with the 0.3-in. cordite this velocity and energy has been obtained at the cost of nearly 30 per cent. higher maximum pressure. A similar remark may be made in regard to the French B. N. powder if compared with the ballistite. Its velocity and energy are obtained at a high cost of maximum pressure, and it is interesting to note how the velocity curve of B. N., which for the first four feet of motion shows a velocity higher than that of any other explosive, successively crosses other curves, and gives at the muzzle a velocity of 500 f. s. under that of cordite.

The velocities and energies at the principal points indicated in Figs. 1 and 2 are summarized in the annexed table, which shows for each nature of explosive the advantage in velocity and energy to be gained by a corresponding lengthening of the gun.

Fig. 3 offers an interesting illustration of a point elsewhere adverted to. Cordite and ballistite leave no deposit in the bore. Round 1 with R. L. G. was fired with a clean bore. The difference in velocity between round 1 with a clean bore and rounds 2 and 3 with powder deposit in the chase is very clearly marked, and it is shown that in this instance the effect of the foul bore is only distinctly evident when the length exceeds 40 calibers. From 40 calibers onwards the loss of velocity due to a bore encrusted with deposit is very distinctly shown.

* Compare Noble and Abel, loc. cit., p. 109.

TABLE SHOWING THE VELOCITIES AND ENERGIES REALIZED IN A 6″ GUN WITH THE UNDERMENTIONED EXPLOSIVES.

Nature of explosive and weight of charge.	Length of bore, 40 calibers.		Length of bore, 50 calibers.		Length of bore, 75 calibers.		Length of bore, 100 calibers.	
	Velocity.	Energy.	Velocity.	Energy.	Velocity.	Energy.	Velocity.	Energy.
Cordite, 0.4″ dia., 27.5 lbs.	2794	5413	2940	5994	3166	6950	3284	7478
Cordite, 0.35″ dia., 22 lbs..	2444	4142	2583	4626	2798	5429	2915	5892
Cordite, 0.3″ dia., 20 lbs...	2495	4316	2632	4804	2821	5518	2914	5888
Ballistite, 0.3″ cubes, 20 lbs.	2416	4047	2537	4463	2713	5104	2806	5460
French B. N., 25 lbs......	2422	4068	2530	4438	2700	5055	2786	5382
Amide Prismatic, 32 lbs...	2225	3433	2331	3768	2486	4285	2566	4566
R. L. G_2, 23 lbs.	1533	1630	1592	1757	1663	1929	1705	2016

Under the title, "Inspection of Cotton for Use in the Manufacture of Gun-cotton," Charles E. Munroe gives in *Jour. American Chemical Society*, **17**, 783-789; 1895, a detailed description of the tests which are applied, with data from the testing of several samples.

The erection of batteries of pneumatic guns along our coast makes the account of the "Pneumatic Torpedo Plant at Fort Winfield Scott," San Francisco, contributed to the *Mining and Scientific Press*, San Francisco, December 21, 1895, of interest, especially as it was constructed by Mr. Rix.

The Rix air compressors used for compressing the air are two in number and of the duplex pattern, each of about 400 H. P. capacity. The air is compressed in the first cylinders to 75 lbs. to the square inch, and is thence taken into a cooling tank containing about 1000 running feet of one-inch copper pipes, in which the air is cooled from the temperature of its discharge from initial cylinders, which is about 320 degrees, to the temperature of the water or thereabouts. It is delivered to the intermediate cylinder at about 65 degrees in temperature, and is there compressed in a single-acting ram to about 400 lbs pressure. The air is thence taken again into the intercooling chamber, through about 400 feet of copper pipe, and is cooled again to the temperature of the water, and is delivered to the high-pressure cylinder at the same temperature as to the intermediate cylinder.

In the third cylinder it is compressed to 2000 lbs., the air being delivered at a temperature of about 358 degrees. This is conducted to the third intercooler, where the temperature is reduced to about 65 degrees, and is thence conducted to the storage reservoir.

The engines which drive this compressing plant are of the Meyers cut-off style, and are extremely well balanced and well constructed; in fact, the cards and the results show that these compressors have a mechanical efficiency of about 85%, and throughout the system there is a saving of 36% over the work required to compress the air to 2000 lbs. adiabatically.

The amount of air delivered per hour, at 2000 lbs., is about 460 cubic feet, which is more than ample to keep the machines in operation; in fact, during the test one machine would have been sufficient to have maintained the number of shots.

One feature about this whole compressing plant is the facility with which the air is cooled. Each cylinder has a number of independent circulations, notably the high-pressure cylinders, where four circulations are introduced, each independent of the other, viz., a circulation for the head and valves, two circulations for the cylinders, and a circulation of water within the ram itself while it is in operation. This preserves the packing of the ram and at the same time contributes largely to the cooling of the air during compression.

During the operation of the plant the initial temperatures, that is the temperatures of the inlet for each air cylinder, did not exceed 70 degrees, while the temperature for the discharge of the air varied from 290 to 350 degrees.

The mechanical efficiency of the plant, that is the ratio of the indicated horse-power in the steam cylinders to the I. H. P. of the air cylinders, was 85½%, which is quite high, considering the fact that the machines were not designed for extra economical use, the idea being to provide for the Government something that could be operated easily and which was not easy to get out of repair.

After passing the intercoolers the air is delivered into 24 storage tanks, each 16 inches in diameter by 24 feet long, containing about 650 cubic feet.

These tanks are connected with the firing manifolds. These manifolds are of complex construction, designed so as to admit

the air to any or all of the guns and to admit the air to any or all of the storage tanks.

The air in the storage tanks is maintained at 2000 lbs., while the air delivered to the storage tanks of the guns is at 1000 lbs. pressure.

The guns themselves are very interesting in their character. They weigh about 70 tons each, above their foundations, are 50 feet long by 15 inches in bore. They can fire projectiles of any caliber from 8 to 15 inches, the difference in caliber between the full and the sub-caliber being made up by wood pistons in four sections which surround the projectile and which fly off immediately upon leaving the gun. These projectiles vary from 11 feet long and 15 inches in diameter for the full caliber to 8 feet long and 8 inches in diameter for the sub-caliber. The former carry 500 lbs. of dynamite explosive and the latter about 100 lbs.

The guns are easily traversed around the whole 360 degrees of circle, by an electric motor placed within one of the supports of the gun, and the connections of this motor are so arranged that it will also operate the mechanism for elevating and lowering the muzzle. The gun is ranged from 0 to 35 degrees, which is considered ample for all ordinary purposes. The greatest range obtained with the 8-inch projectile, carrying 100 lbs. of dynamite and which flies under a loss of pressure of about 100 lbs., was 5000 yards and slightly over. This may be considered the maximum flight for usual purposes. The 10-inch is proportionately less, and the 15-inch projectile, which carries 1000 lbs of dynamite and weighs 1100 lbs., has a range of from 2000 to 2500 yards. All of these projectiles may be thrown accurately, in fact there is no reason why, with the same pressure, the same amount of air wasted in the throwing of the projectiles, the same weight of projectile, and the same character of projectile, the atmospheric conditions being the same, it should not land practically in the same place. The results at Fort Point demonstrated this. The 8-inch projectiles were thrown from 5000 to 5070 yards, and were placed in the target, 70 yards in length by 30 yards in width, which far exceeded the Government requirements.

The material used in these projectiles is nitro-gelatine. The whole projectile is of an intricate mechanism, and has provisions made for exploding the charge either by direct impact, side impact, or by a delay of from one to three seconds. These pro-

jectiles are expensive, probably costing $1000 each, and their capacity for destruction is fully proportional to their expense.

In the test at Fort Point the 15-inch projectile at 2000 yards threw up a column of water 350 to 400 feet high and 100 feet in diameter at the base, showing conclusively that it would be amply capable to destroy, within a range of 100 feet, the largest man-of-war.

The boilers which actuate this plant were manufactured by the Chandler & Taylor Co., of Indianapolis, are of about 500 H. P. capacity and are operated under forced draught, the idea being to keep the stacks low enough to be invisible from the bay. All of the fans which furnish the forced draught are each capable of furnishing 13,000 cubic feet of free air per minute to the grates. The boilers are fed by Deane duplex steam pumps, which are reinforced by sets of injectors.

The dynamo is operated by an Armington & Simms engine, of about 50 H. P. The dynamo is capable of furnishing 300 amperes, at 125 volts. The dynamo was manufactured by the Electrical Engineering Co., of this city, and is first-class in every respect. It also furnishes about 50 lights for the engine-room and offices during the evening.

The compressors and guns have exceeded all the requirements exacted by the Government. There was not one hitch or delay during the tests, excepting those caused by the weather, and judging from expressions, the entire Department feel that they have in these guns and the machinery to operate them a most efficient and satisfactory plant.

Shortly after noon on January 2, 1896,
occurred at 309 N. Second Street, St. Lo[illegible] thr
lives were lost, a large number of persons [illegible]d,
destroyed, and much other damage eff[illegible]
in the St. Louis papers, kindly supplied us by Pr[illegible]
appears that a quantity of fireworks, of an [illegible]
$8000, were stored in the building and that [illegible]
custody of Mr. H. B. Grubbs, to whom they
by Detwiller & Street, of New York, wi[illegible]
field, New Jersey. The explosions or[illegible]
of which was undetermined, but which
and there were three successive expl[illegible]

explosions was noticeably local and believed to be unlike the effect produced by a gunpowder explosion. For this reason the damage done was attributed to the explosion of "fire-crackers" of the variety known as "cannon crackers," "up-to-date crackers" or "dynamite crackers," and which were popularly supposed to contain dynamite. From the reports of the testimony before the coroner it appears that there were about 1000 boxes of Chinese and American cannon crackers in store, the largest of the latter being 15 inches long by 2 inches in diameter and having a 1-inch bore.

Five samples of fire-crackers taken from the wrecked building were submitted to Prof. Charles R. Sanger, of Washington University, for analysis, and he testified that the composition in the "up-to-date" fire-crackers consisted of 74 parts potassium chlorate, 24 parts sulphur and 2 parts charcoal or some other composition of carbon; that the charge in the large cracker was 150 grains and in the small one 10 to 12 grains; that the charges were confined by a tamping of clay; that the composition was fired by friction and by percussion; and that, in his opinion, if a considerable number of these fire-crackers were exploded they would cause others near them to explode.

From the St. Louis *Republic* of January 4, 1896, it appears that no law existed governing the storage of such explosives. This is evidently another example of spontaneous explosion due to contact of a chlorate with sulphur.

On December 6, 1893, an explosion of a cylinder of coal gas occurred on the wharf of the New Jersey Steamboat Co. at Albany, N. Y., by which two men were killed. Suits for damage were brought by the heirs of each of the deceased, the evidence being identical, but the plaintiff and the judge being different in each of the two cases. In the first case the plaintiff won, in the second case the plaintiff was non-suited and lost. Both cases were appealed, and in each the defendant won. Both cases were again appealed to the court of last resort, and through the courtesy of Dr. W. P. Mason we are in receipt of the plaintiff's brief in the case of Mary Egan *vs.* N. J. Steamboat Co. From this we learn that the cylinder was of steel; that it was seven inches in diameter by fifty-four to fifty-five inches long; that it was filled with illuminating gas made by mixing water gas and ordinary coal gas in such proportions as to produce a

mixture of nearly equal parts of hydrogen and carbon monoxide, with sufficient heavy hydrocarbons added to make it luminous; that the cylinder weighed about 100 lbs., and that the weight of the added gas was so small that, it is claimed, a laborer handling one of these cylinders could not tell, except by testing it, whether it was full or empty.

The counsel makes the points, among others, that the defendant was guilty of culpable negligence, under the common law, in directing the intestate to handle this cylinder, in its then condition, charged with gas to a high pressure, under the circumstances of the case; that he was guilty of violation of Sec. 4472 of Revised Statutes U. S., forbidding the transportation of nitroglycerin and like dangerous articles by passenger steamers; and that *illuminating gas* is *an explosive burning fluid* like the coal oil, camphene, benzine, and others cited in the statute. He cites the opinions of courts deciding that "gas" is an explosive. It is remarkable what confusion of thought regarding the properties of matter exists in the minds of otherwise intelligent men.

The exciting cause of this explosion has not been ascertained. It is stated that the explosion occurred just as the laborer, who carried the cylinder on his shoulder from the steamboat to the storehouse, was laying it down on the storehouse floor.

S. J. von Romocki presents in two stout volumes his "Geschichte der Explosivstoffe;* volume I being devoted to the history of the chemistry of explosives, the technology of explosives, and to military and naval mining from their beginning up to the present century, while volume II treats of the history of smokeless powders up to the present time.

The extent of ground covered may be judged from the following titles of the chapters in volume I: War-fire up to the introduction of saltpeter; the first explosive; explosives in the Occident; the Fire-book of Marcus Graecus; the Fire-book in Konrad Kyeser's "Bellifortis"; the Fireworks-book and the explosives of the 15th century; Johannes de Fontana's Sketchbook; the beginning of sub-terra mines; the progress in the technology of explosives in the 16th century; the powder-ship before Antwerp in 1585; petards and marine mines; explosive missiles with

* Large 8vo. Vol. I., 394 pp.; Vol. II., 324 pp. Berlin: Robert Oppenheim (Gustav Schmidt), 1895.

flint and steel igniters; moveable and controlled torpedoes before La Rochelle in 1628; further inventions of Cornelius Drebbels; rocket and fish torpedoes. Copious extracts, in the original languages, are given from the Latin, Greek, Arabic, Chinese and other manuscripts and books. The chapters of volume II bear the following titles: Saltpeter powder with varying proportions of sulphur; chlorate powder; ammonium nitrate powder; picrate powder; xyloidine; the discovery of gun-cotton; gun-cotton up to its abandonment in Austria; nitro-cellulose from its revival in England to the discovery of the Vieille powder; the nitro-cellulose powders of the present time.

The work is a scholarly production, and bears evidence of the most painstaking research into the literature of the subjects treated of, while the numerous references are given with great detail and exactitude. The volumes are illustrated with 140 cuts, those in the first volume being of especial interest.

"Cellulose, an Outline of the Chemistry of the Structural Elements of Plants, by Cross and Bevan," * is the most recent and most valuable work on this subject that has appeared, and it contains so much new and original matter that all who are engaged in manufactures in which cellulose in its various forms is employed, as for instance in the production of the explosive cellulose nitrates, should be familiar with its contents.

Apropos of the use of these nitrates in the manufacture of smokeless powders the authors remark: "These industries are in a highly developed condition, the manufacture being carried on with the greatest precision, on the basis of an extensive empirical knowledge of the properties of the products. It must be admitted, however, that, in the absence of any precise knowledge or even accepted theories of the constitution of the cellulose nitrates, there remains a vista of progress to be opened out by the solution or partial solution of this important problem."

"Coal Dust as an Explosive Agent, as shown by an Examination of the Camerton Explosion,"† by Donald M. D. Stuart, develops the theory that a colliery explosion, in which coal-dust is the principal agent, comprises numerous local explosions,

* London: Longmans, Green & Co., 1895. 8vo. 320 pp., 13 plates.

† New York: Spon & Chamberlain, 1894. Sm. 4to. 103 pp., 7 large plates.

separate in time and in space, at irregular intervals, where the normal supplies of atmospheric oxygen are greatly increased, and is caused by the explosive combustion of accumulations of hydrogen gas, derived from the coal-dust in the antecedent spaces, by a series of chemical actions of constant sequence, which produce heat for regeneration without auxiliary intervention, and are constantly reproduced along the path of the coal-dust under the conditions named.

An elaborate discussion of Mr. Stuart's theory and data will be found in *Trans. Am. Inst. Mining Eng.*, **24**, 905-917; 1895, to which Mr. Stuart replies in a very satisfactory manner in a paper read at the meeting, February, 1896, and to be published in volume 26.

Crosby, Lockwood & Son, London, announce the appearance of "Nitro-explosives," by P. Gerald Sanford. 270 pp. 1896; and Hirschfeld Bros., New York, announce "The Origin and Rationale of Colliery Explosions," by Donald M. D. Stuart.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

HOMING PIGEONS FOR SEA SERVICE.

A Lecture delivered at the Naval War College, Newport, R. I., July 20, 1896, by Professor H. Marion, U. S. Naval Academy.

So much has been written about the use of pigeons as despatch-bearers on land that it would appear superfluous to dwell upon what has already been said about them.

The principal object of this paper is to discuss the employment of pigeons as message-bearers over bodies of water, a question which has of late attracted considerable attention in this country and abroad.

There are many instances of the early employment of pigeons for transmitting intelligence from ship to shore. The fancy for pigeons was already in vogue among the Egyptians, the Greeks and the Romans. It is recorded that pigeons were used as message-bearers by the early navigators of Egypt, Cyprus and Candia, who often announced their approach by pigeons three days in advance of their actual arrival at port. The Venetians used them during the 12th century with great success in their war with the Turks, and it is said the island of Candia was once saved by a pigeon, which carried to Venice the news of the return of the Turks in time to send a fleet, which prevented the invasion of the island by the enemy. In memory of this event, pigeons were, for centuries, fed at the expense of the Venetian government in the famous square of St. Mark. Further notable instances of the use of pigeons as war messengers are the siege of Haarlem in 1573, that of Leyden in 1575, and the bombardment of Antwerp in 1632. The organization of the modern military pigeon systems, however, may be said to date only from the siege of Paris (1870-71), where homing pigeons were most extensively and successfully used.

France took the lead in establishing a military pigeon service and was soon followed by almost every continental nation of Europe. The military budget of France assigns an annual credit of nearly 100,000 francs for the maintenance of the military and maritime pigeon lofts. In accordance with law, the military authorities have also a right to requisition messenger pigeons from private lofts, and an annual census is taken of all available trained birds which might be utilized as auxiliaries to the regular military contingent. In order to encourage the breeding and training of homing pigeons, the government offers yearly premiums to the various columbarian societies in the shape of medals, diplomas and money awards. The experiments with pigeons for naval purposes were commenced in France a few years ago with the co-operation of the Engineer Corps of the Army, which loaned some of their pigeons to the Navy and detailed a number of their men (*sapeurs du génie*) as instructors at the various ports. The naval pigeon stations at Brest, Nantes, Toulon and Marseilles have given excellent results.

Each year, in April, a certain number of sailors are instructed in the care and training of pigeons for sea service. A torpedo-boat is assigned to each station for the training of the birds, which are liberated at sea, beginning with five miles, and by gradually increasing the distance, the birds soon become accustomed to their work. It has recently been proposed further to extend the French naval messenger pigeon service by having three different lines of communication radiate from each station, viz.:

1. By pigeons trained seaward as far as 300 miles, towards the English coasts on the Atlantic Ocean, and towards Corsica, Sardinia, Algeria and the Balearic islands in the Mediterranean.
2. By pigeons trained from each naval station towards Paris.
3. By pigeons trained to connect the various military ports with each other.

To insure these communications, birds are to be distributed as follows: Cherbourg, 500; Brest, 600; Lorient, 500; Rochefort, 500; Toulon, 1000; Paris, 500. The line of communication by pigeon post, established some time ago by the maritime authorities at Toulon for service between that port and Calvi (Corsica), is now in full operation, and a new line between Bizerta and Bonifacio has recently been established, and flights will be attempted

this year between Algiers and Marseilles, a distance of 480 miles, with possible relays at Ajaccio (Corsica). In the colonies a regular service exists between the Reunion Island and Mauritius. French societies all along the coast of Normandy are constantly flying their birds from Portsmouth and Plymouth, and these birds have often crossed the English Channel at its widest part. But by far the most interesting and conclusive experiment ever attempted in Europe, with a view of demonstrating the value of homing pigeons for sea service, was undertaken last year, by and through the initiative of *Le Petit Journal*, of Paris, as the result of a controversy with the Paris *Figaro*, on the possibility of receiving news by pigeons from the long delayed steamer La Gascogne, of the Cie. Transatlantique, on her return trip to New York two years ago.

The writer of the *Figaro*, who claimed to be an authority on pigeon matters, stated that pigeons could never fly 100 miles at sea, and would become sea-sick on board ship and consequently unable to leave it.

Parenthetically, I will state that I took occasion at that time, through the *New York Herald*, to contradict this statement, and cited an instance when pigeons, which had been purposely kept confined 21 days on board the Monongahela, between decks, had returned to the Naval Academy loft at Annapolis, over a distance of 200 miles. (See article by Lieutenant A. M. Knight, U. S. N., Proceedings U. S. Naval Institute, No. 72, 1894.)

The director of the *Petit Journal*, in order to settle the question in dispute, moved by high humanitarian motives, chartered at his own expense, aided by a popular subscription, the steamer Manoubia, of the Cie. Transatlantique, for that purpose. This great and novel undertaking, which cost nearly $5000, was carried out as projected. About 4500 pigeons, belonging to various columbarian societies of France, Belgium, Holland and England, were put on board the Manoubia, June 30, 1895, at St. Nazaire. All arrangements for their care and comfort had been carefully made, and the different cabins had been turned into so many minor lofts, each dedicated to this or that country and province from which the birds, occupying it, had come.

The operations were carried on under the management of the *Le Petit Journal* and a committee representing the various societies, and were under the intelligent supervision of M. Ch. Sibillot,

editor of *La France Aérienne*, the leading columbarian newspaper in France.

Four tosses or liberations took place:

800 pigeons were liberated at 146 km., at about 91 miles from nearest shore (Pointe du Croisic).

1600 pigeons were liberated at 200 km., at about 125 miles from nearest shore (Pointe du Croisic).

600 pigeons were liberated at 300 km., at about 187½ miles from nearest shore (Pointe du Croisic).

Finally, 1500 pigeons were liberated at 500 km., at about 312½ miles from nearest shore (Pointe du Croisic).

Of the 800 pigeons liberated at 146 km. (about 91 miles), none returned to the ship.

Of the 1600 pigeons liberated at 200 km. (125 miles) during a heavy rain and strong wind, only three returned to the ship. Of the 600 pigeons liberated at 300 km. (187½ miles), only one returned to the ship. Of the 1500 pigeons liberated at 500 km. (312½ miles), twelve remained on the Manoubia, making a total of only sixteen pigeons out of 4500 which refused to seek land. During the trip, which lasted ten days, the pigeons drank, ate and cooed, apparently indifferent to their being on board ship, and none showed any signs of sea-sickness, thus disposing of the theory that pigeons would be unfitted for flying from that cause. In fact, pigeons or any high-flying birds stand transportation at sea much better than over land, as the rolling and pitching of the ship, providing they are not too crowded in their baskets, has no different effect than that which would be naturally produced by the swinging of the branches on which they are accustomed to perch when free.

The results obtained by this experiment surpassed the most sanguine expectations of the promoters of the enterprise.

The first prize, offered by the President of the French Republic, was won by a pigeon from Tours, which made the distance of 743 km. (about 465 miles), of which 500 km. (312½ miles) over water, in 15 hours and 12 minutes, at an average speed of 48 km. 850 m. per hour (30½ miles).

One of the most interesting features of the experiment was the speed made by these pigeons, of which Prof. Caustier, a member of the Zoölogical Society of France, has made an exhaustive study. From previous observations the speed of pig-

eons that had been flown over water was said not to have exceeded 35 km. (22 miles) per hour. (This statement was erroneous, as some of the Naval Academy pigeons had made over 100 miles at the rate of 40 miles an hour.)

The speed of pigeons liberated from the Manoubia at 500 km. (312½ miles) varied from 40 to 48½ km. (25 to 30½ miles) per hour.

At 300 km. (187½ miles) a pigeon of Rochefort flew at a speed of 60 km. (37½ miles) over a distance of 450 km. (281 miles); others made from 55 to 60 km.

At 200 km. the speed rose, in some instances, to 88 km. (55 miles) per hour. The average speed, however, was somewhat inferior to that made over land.

It must be stated here that very few of the pigeons liberated from the Manoubia had ever flown over water before.

Considering all the disadvantages of unfavorable weather and lack of training, the experiment proved a conclusive success. The utmost enthusiasm was aroused in Paris, Brussels, and at all the columbarian centers of Europe, and the owners of the winning birds received a great ovation.

From careful observations made by M. Ch. Sibillot, one of the chief promoters of the experiment, who remained on board the Manoubia, it appears "That the height of the flight of the birds, when liberated at sea, increased in proportion to the distance they are from land." When liberated at 90 miles from land they circled at an altitude of 150 to 200 m.; at 125 miles they visibly rose much higher; at 187 miles they were at least 600 m.; and at the long-distance liberation of 312 miles they were soon lost from sight almost vertically above the vessel, and it was noticed that, at this distance, the birds pointed at once towards the sky, their beak and tail being in an almost perpendicular position and then formed [illegible] separate squads, each taking their flight towards their respe[illegible]nes, some flying directly against the sun, in spite of [illegible] that pigeons never fly in that manner.

[illegible] arises in reading [illegible]

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[illegible] s French [illegible]

[illegible] voyagers [illegible]

[illegible] mies."

Some of the best known authorities, among whom is Mr. Tegetmeier, the English expert, claim that homing pigeons fly mostly by sight. Others claim that they are influenced by the position of the sun, by atmospheric currents, and by the magnetic attraction of the earth. Others, that they possess an intuitive sense of orientation (or taking one's bearings instinctively), developed to a very high degree, and common to all animals, *civilized* man excepted.

In order to illustrate the fallacy of the pure sight theory, let us consider the following examples of flights actually made, with distances computed from *Bowditch's useful tables of visible distances at sea*. Taking height of land about Cape Henry at the mouth of the Chesapeake Bay at 75 feet above sea-level, pigeons liberated from the Monongahela, 110 miles off shore, would have been obliged to rise 5600 feet, or over one statute mile, to see the land. Taking as another illustration, height of land about Newport at 165 feet (height of Beacon Hill), visible 17 miles at sea-level, a pigeon liberated at 150 miles would have to rise 10,200 feet, or nearly two miles above the sea-level.

Taking height of land about St. Nazaire, France, at 400 feet, the pigeons liberated from the Manoubia, at 312 miles off shore, would have had to rise to the enormous altitude of 47,000 feet, or nearly nine statute miles, to see land. Everybody knows that at such an altitude no bird could live or fly.

The pure sight theory is therefore inadmissible; and further, to prove its fallacy, it is well known that pigeons, when liberated from balloons at high altitudes, invariably drop almost perpendicularly towards the earth, and only regain their equilibrium when reaching a more congenial atmosphere.

In this connection it may be interesting to note that M. Andrée, who will attempt to reach the North Pole by means of a balloon, will take with him a number of homing pigeons, which will be liberated at certain intervals with messages giving an account of the progress of this novel arctic expedition.

Another point which I wish to discuss is the prevailing mode of calculating the distances flown by pigeons by the so-called "air-line" gauge. A pigeon *never* flies in a perfectly straight line, and is often carried far from its course by contrary winds and atmospheric currents. Experienced and strong pigeons, however, are able to fly against a heavy head-wind by what is

commonly called "tacking." The straight air-line from point of liberation to point of arrival as a gauge of their actual speed is therefore fallacious, and the real distance covered *cannot* be exactly measured.

Leaving out all theoretical considerations, the Manoubia experiment with pigeons kept confined for over ten days, and mostly without previous training over water, shows that from a practical point of view the experiment was well worth its cost, and helped to dispel the preconceived idea that pigeons would never become the auxiliaries of the navy and of the sea-faring world, and greatly aided the efforts made on this side of the Atlantic to have this service officially recognized. (Endorsements and recommendations by Capt. R. L. Phythian,* Capt. Wm. C. Wise, Capt. F. J. Higginson, and Commander C. M. Chester.)

After the war of 1870-71 other countries speedily followed the example set by France in organizing messenger-pigeon stations. Germany quickly recognized the importance of this new system of aerial communication, and has now one of the most complete and effective pigeon services in the world. The German Emperor has taken a personal interest in promoting this new service, and frequently uses pigeons to convey messages from his private yacht, the Hohenzollern. The German government, besides having its own system and personnel with a permanent director at its head, offers annually prizes, medals and subsidies to the various columbarian societies of the Empire, of which there are nearly 400. One of the features of the German service is the use of pigeons for communications from outlying light-houses and light-ships. Some years ago one of the lightships, 22 miles from Tornung, off the mouth of the Elbe, broke adrift from her moorings in heavy weather and would have been lost but for the quick intelligence of the accident conveyed to the mainland by the pigeons in 58 minutes. The whole of the German frontier is now connected by pigeon post with the interior

* United States Naval Academy, Annapolis, Md. Respectfully forwarded: March 13, 1894. "Experiments made with homing pigeons at the Naval Academy have, in my opinion, demonstrated that their use can be made valuable in receiving communications from vessels operating near the coast, and that the pigeon service should be established on some recognized basis."

(Signed) R. L. PHYTHIAN, Captain, U. S. N.,
Superintendent.

and headquarters, and the northern coast is studded with pigeon stations under the control of the Minister of Marine.

Italy has an interior military service, and has been particularly active of late in establishing pigeon posts for naval purposes, to be used in connection with the manœuvres of her new fleet. For example, there is a military pigeon post at Rome and another at the island of Maddelena, and the birds fly from one loft to the other at the rate of about 20 miles an hour. The total distance is 170 miles, and of that, 150 miles is over water. Other naval lofts are situated at Piscaya and Cagliari, Sardinia, the latter constituting part of the Napoli-Cagliari line. The distance between the two places is 294 miles. Birds liberated at sea from Italian vessels have made a distance of as much as 287 miles over the sea at about 31 miles an hour. These pigeons, sent out with despatches during the recent manœuvres, arrived many hours, and often days, before the despatch boats sent out at the same time.

Italy has, moreover, connected Massowah and Assab, in Africa, by pigeon post, which rendered valuable service during the recent Abyssinian campaign, when the telegraphic communication had been interrupted. The twelve principal governmental lofts in Italy are controlled by the Engineer Corps; and Captain Malagoli, the chief of the service, has made a great advance by training the same pigeons to fly back and forth (there and return) between Rome and Civita Vecchia, the nearest port to the capital and an important strategical point. This remarkable result can only be obtained over short distances, not exceeding 60 miles, by long and careful training, feeding the birds at one end of the line and keeping their mates and young ones at the other. (Experiments from shore to ship and *vice versa*. See Lieut. Benson's article, Proceedings U. S. Naval Institute, pp. 592, 593, No. 64.)

The Spaniards, under the initiative of Dr. Diego de la Llave and Don Salvador Castello, have become one of the foremost columbarian powers of Europe. They have a pigeon service in full operation at the present day, their most important strategical lines being those across the straits of Gibraltar from San Fernando and Malaga to Ceuta and Melilla (Africa) and those connecting the Balearic islands with Valencia. These are fixed, regular services. Spain also has pigeon lofts at various coast guard

stations for communication between the different posts, and between the shore and naval cruisers and revenue vessels. The service being used in time of peace to prevent smuggling.

Portugal has also a regular messenger-pigeon service, but mostly for strictly military purposes.

Both Austria and Russia have extensive military and naval pigeon services, and Denmark has of late made great progress in perfecting her lines of communication by pigeon post.

Belgium, especially, has brought pigeon-flying to the highest state of perfection, and in that country it has become the favorite national sport. The present type of the "pigeon voyageur" may be traced to that country, where by careful and judicious crossing and by the strict application of the principle of the survival of the fittest, an almost perfect type of "homer" has been produced.

It would be a wise and economical policy if the government would secure through some reliable agent some of the best Belgian homing pigeons for a naval breëding loft, which should be located at some central point, at Annapolis for instance, on account of its convenient location and mild climate, where birds could be raised from approved strains and shipped to the other stations.

England is the only European power that has no regular pigeon service. However, the Admiralty has been experimenting of late with pigeons belonging to various lofts which are indirectly under the control of the naval authorities. That on Whale Island, Portsmouth, is first in importance and contains about 300 birds. Pigeons from this loft are now regularly liberated from English men-of-war in all parts of the English Channel as far as Ushant. Devonport has also a messenger pigeon loft, and the system is being extended to Sheerness and Queenstown, and it will soon be possible to receive intelligence from ships at sea anywhere between Harwich on the east coast of England and Queenstown in the south of Ireland. Last year about 100 English pigeons were sent to the West Indies and liberated from the cruiser Blake on her return trip to England at regular intervals as to time and place of liberation, announcing her return to the home station. Thus, for example, a vessel returning to port for repairs, coaling, docking, etc., if announced a day or even a few hours beforehand by pigeon post, would

enable the dockyard authorities to make the necessary preparations proportionately sooner, thus making a considerable saving on time and money, and the pigeon service would pay for itself in time of peace. The Dominion of Canada, which has a very complete system of communication by pigeon post leading from her sea-ports to the interior, possesses a naval loft of great strategical importance at Halifax, ensuring communication with Sable Island (a distance of about 150 miles), with a view to signal shipwrecks in the vicinity of that island and to receive rapid communication from vessels cruising between these stations.

The following is taken from an English newspaper recently received (W. M. News, 16, 6, '96, Pigeon training for the Navy):

"For the past two years a considerable amount of money, time and patience has been expended at the Royal Naval Barracks, Keyham, in the training of pigeons, with a view to their being used for the conveyance of despatches. Up to the present the Admiralty have failed to recognize the pigeon depot, and the expense of building and furnishing the lofts has been met by the contributions of the officers of the establishment. From inquiries which the Admiralty have been recently making, however, it is regarded as certain that the training of pigeons at Devonport will be taken over officially by the Admiralty. For many reasons this would be a most desirable step, as besides relieving the present voluntary contributors of their expense in maintaining the lofts in a state of efficiency, it will ensure greater facilities for the training of the birds. Under present arrangements, those interested in the care and training of the birds are dependent entirely upon the willingness of the officers of the instructional torpedo-boats to take the birds for exercise, and, as these vessels rarely go far from Plymouth, there is little chance for the birds having anything but a very limited area for practice. It is now proposed to appropriate a torpedo-boat or destroyer for the purpose of training the birds, and with this object in view satisfactory results are assured. At the Keyham Barracks there are two lofts, one for birds under training only and the other for breeding purposes. At the present time there are 60 birds in the training loft and 8 pairs of breeders with 12 youngsters in the breeding loft. The Devonport birds have been trained to cover the ground west of Plymouth, and the greatest distance of birds released off the Wolf Rock was about 75 miles from land."

In reading these lines one is forcibly reminded of the earlier efforts made in this country with a view to establish this service, which resulted in the establishment of an experimental station under my charge at the Naval Academy about six years ago; and of one at Newport under the late Lieut. F. W. Nichols, which unfortunately was soon discontinued. In 1891 about 20 birds belonging to the Signal Corps station at Key West, which had been discontinued on account of the transfer of the Weather Bureau to the Department of Agriculture, were sent to the Naval Academy for experimental purposes with a view to demonstrate their usefulness for the Navy. They were domesticated in the tower of the boat-house, where a model loft was fitted up, mostly by private enterprise. During these years the work was carried on without any regular appropriation for its maintenance, and each year during the summer cruise of the naval cadets many experiments were made, which fully demonstrated the value of homing pigeons for naval purposes, as shown by the reports made to the Superintendents of the Naval Academy by Lieut. W. S. Benson, Lieut. F. K. Hill, Commander C. M. Chester, Lieut. A. M. Knight, and Lieut. E. W. Eberle.*

In this connection I beg leave to quote an extract from a letter addressed to me by Gen. Greely, Chief Signal Officer of the Army (Nov. 8, 1895). Speaking of the Key West pigeons, he says:

"These pigeons were originally received as donations from owners of the lofts in the United States whose birds had made the best flights. They were sent to Key West Barracks, where a loft was established. From this stock young birds were bred which, at first, were trained for short distances and gradually extended until flights had been made from Havana to Key West. It seems, however, that you have been more successful, from the fact that birds under your training and liberated at sea at a distance of 102 miles off Cape Henry returned to Annapolis

* Lieutenant Eberle, who was to deliver a lecture at the War College on the strategical importance of a naval messenger-pigeon service, illustrated by most carefully prepared charts, was unfortunately unable to do so on account of his being ordered to the Pacific Coast.

(total distance about 230 miles).* It is therefore to be regretted that for lack of funds the maintenance of the station at the Naval Academy has been discontinued, as well as the future establishment of lofts at the most suitable naval stations on the Atlantic, Gulf, and Pacific coasts."

Since then, through personal efforts aided by articles periodically published in the Proceedings of the U. S. Naval Institute, to which belongs the credit of having kept this work before the Navy, this service has been officially recognized this year by the Honorable Secretary of the Navy and lofts are to be established at several of the principal navy-yards by the Bureau of Equipment, viz., at Boston, Newport, New York, Norfolk, Key West, and Mare Island.

No breeding and experimental station has yet been designated, but it is to be hoped that one will be established, as this service would be incomplete without it, its main object being the creation and breeding of a strain or type of "naval" pigeon capable of performing fast and continuous long-distance flights over water.

With that addition and a suitable appropriation by Congress for its support, this new service, under competent and intelligent supervision, is destined to render at a trifling cost valuable assistance to the systems of naval signals and coast defense as advocated respectively by Lieutenant-Commander R. Wainwright and Lieutenant Niblack in their admirable articles in the Proceedings of the Naval Institute, and to become one of the best of its kind in the world, and we will then be able to say, as did the promoters of the experiment of the Manoubia, "We have got the pigeons, we have got the stations, we have got the ships, and we have got the sea."

* This distance was increased during the summer cruise of 1896 by the flight of Naval Academy birds liberated from the Monongahela in lat. 37° 04′ N., long. 73° 16′ W., 132 miles off Cape Henry lighthouse, 191 miles air-line distance and 257 miles from Annapolis via Cape Henry. Since then the Naval Academy loft has been closed and the birds distributed among the Key West, New York, and Newport stations.

DISCUSSION.

Speed Control in Modern Steamers. (See No. 77.)

Wm. Barnum Cowles.—Lieutenant M. L. Wood's paper on "Speed Control in Modern Steamers" can be discussed from two standpoints:

1st. The necessary change in the régime of the ship.

2nd. The practicability of the proposition.

From the first standpoint there is some danger of prejudice vitiating a clear judgment on the merits, for when human nature is called upon to break away from tradition and move in a new direction it shows itself possessed of far more inertia than matter, and this is more especially true where the human nature has had military training.

If the proposition affected *matériel* only there would be slight danger of prejudice, as the last twenty years have opened and broadened our minds very thoroughly in this respect. But the proposition, though not entirely new, is revolutionary in its effect on *personnel*, inasmuch as it puts the direct operation of the main engines of the ship in the hands of the officer or petty officer on the bridge or in the conning tower, and does not propose to relieve the officer below from the responsibility in maintaining the propelling engines and auxiliaries in good condition. This puts new duties upon the officer on the bridge, duties for which he has absolutely no training, duties involving a judgment and experience entirely out of his line and knowledge and which he could not by any possibility exercise, even if he possessed them, owing to his location; this is an added strain as well as a hardship and injustice to him. This also puts upon the officer in the engine room a very great increase of anxiety when—heaven knows!—his cup of that seems to be running over now.

Let me be very distinct about this point, for my friend Lieutenant Wood has, without intending to do so, entirely misconstrued the situation below decks when he assumes that his proposition *relieves* in any way the officer stationed there. With the multiplicity of duties involved in the operation and maintenance of modern engines, boilers and their legion of auxiliaries, the anxiety and strain on an officer are certainly ample when he has control in his own hands and can "work out his own salvation," but to put the control and operation in the hands of another, and that other removed entirely from the scene, still leaving the responsibility for the maintenance of good working on the shoulders of the officer below, is to increase the strain and anxiety upon the latter to a point beyond ordinary endurance and, under existing conditions, would be nothing less than reckless. This is a true and moderate statement of the situation below, and is not a matter of argument or opinion, but of fact.

Notwithstanding all this I agree with Lieutenant Wood that it would be a good thing for the efficiency of our war-ships if we could handle and control the motive power directly from the point where the movements of the ship are watched and controlled; and if this can be done in a manner to increase the efficiency of the ship as a whole, by all means let us have it *regardless* of persons or prejudices or individual hardships.

The régime of the ship must give way and be modified to suit improvements, when these have proved themselves to be such, and this in spite of any question of *personnel;* for the last word in any such case is *patriotism*—the good of the whole Navy, *for the people,* not for the Navy—the attainment of the most efficient combination of *personnel* and *matériel* in the fighting machines of the country.

From the second standpoint—practicability—I have seen and examined a number of small steamers, the largest about 100 feet long, which had their main engines operated from the pilot-house by separate and direct levers and rods to throttles and reverse bars. These were passenger boats. This method was adopted by their owners to gain quickness of manœuvring in making a string of small landings close together. The boats were working satisfactorily when I examined them and the unusual feature was certainly an improvement.

The largest engines so operated were not more than 9 and 16 inches diameter by 10-inch stroke (compound, twins). From the above to a naval cruiser or battle-ship, however, is a far cry. I recollect reading some years ago (in the marine reports of the *New York Herald,* I think) of the captain of a French transatlantic liner claiming to have saved his ship from collision with an iceberg by reversing, from the bridge, one of the twin engines at one gulp from full speed ahead to full speed astern and throwing his helm hard over. As I recollect it the ship was fitted with a gear to stop or reverse the main engines from the bridge in cases of extreme emergency, this was the first and only time it had been used, and it was used then only as a *dernier ressort,* the fog lifting and showing the berg dead ahead only a cable's length or so—something had to go, so the captain, who was on the bridge at the time, instantly chose the chance of wrecking an engine. There was no published report from the chief engineer and nothing was said about any damage resulting in the engine room, so in this case the results were probably not serious. This was solely an emergency gear as I recollect it, and not used or intended for the regular operation of the engines.

There are doubtless other cases, hundreds of them, where small steamers have their engines worked from the pilot-house, but the case where large engines have been regularly worked in this way will be found lacking, I fancy. In fact, if it were *safe* to do it it would have been done and generally done in a large class of merchant vessels before this, because, aside from the danger to the engine and machinery itself, it is a most desirable thing to manipulate it from the bridge.

When we can get a way to make steam without water, a way to condense it without forming water, when we can virtually reduce the momentum of moving parts in a 10,000 H. P. engine to that in a 100 H. P.

engine, when we can operate our main engines *regardless of all immediate surroundings and conditions and connections,* which the five senses of man are now often strained to detect properly and soon enough, *then* we can shut the engines up in a gas-tight, steam-tight, water-tight compartment and operate them from the bridge, or anywhere else we choose, by simply pressing a button or throwing a small lever with the pressure of a finger. *That* will send the " man at the throttle " to some other station—probably the bridge.

Lieutenant Wood seems to have put his attention on a mechanical means for operating the throttle and reversing gear from the bridge, and he proposes to operate them *in unison,* which will not do. This, however, is aside from the point; any one of a half-dozen schemes for doing this can be worked out with perfect success so far as the operating device is concerned. The real question is—What is going to happen to the engines and machinery when you get out of sight of them, out of hearing of them, out of touch with them, yes, out of *taste* and *smell* of them, and commence to " make the wheels go round " by pressing your button or lever on the bridge?

I say again, this idea of manipulating engines from the bridge is a most desirable thing, and we shall never have the perfect motor for driving a floating fighting machine until we have one which can be so operated, but the science of engineering has not progressed far enough yet to design and construct battle-ship engines and machinery which can be so operated with safety to themselves. It takes no prophet to predict that when we have such motors they will not be directly actuated by steam.

PROFESSIONAL NOTES.

ON THE PERFORATION OF HARD-FACED ARMOR PLATES.

By Mr. C. A. Stone.

With the adoption of hard-faced armor the formulas for the striking velocity required by an armor-piercing projectile for the perforation of an armor plate of a given thickness become no longer applicable.

These formulas presupposed that a projectile would perforate the plate unbroken and but little deformed. If the effect upon the projectile were small enough to be ignored, the differences between the results obtained at the Proving Ground and those to be calculated by the formula would be due to the differences in resistance of the plates tested. When the manufacture of homogeneous plates had reached a point of reasonable uniformity, and with uniformly good projectiles, these differences were comparatively small, and the conditions were such that a formula for the perforation of a homogeneous plate could be used, agreeing fairly well with the results obtained by practice, making due allowance for variations in quality of projectiles and plates.

With the universal adoption of hard-faced armor these formulas become no longer applicable. The object of the hard face of the armor was to break up and totally deform the projectile. If the hard face served this purpose the conditions were such that the formulas were of no use whatever, except for the purpose of determining approximately a velocity with which the plate would be perforated if the hard face did not break up and deform the projectile.

In the London *Engineer* of July 3rd, 1896, there is an article entitled "Herr Krupp on the Perforation of Steel Armor,"* in which is given what is called "a fairly sound rule-of-thumb," that for steel plates with hardened faces 2000 f. s. striking velocity will give about the caliber perforation, and other velocities proportionately. An oil-tempered nickel-steel plate 6 or 8 inches thick would probably be perforated with a 6 or 8-inch armor-piercing shell, weight one hundred or two hundred and fifty pounds, with a striking velocity of about 1450 f. s. For a 6-inch plate and 6-inch gun the DeMarre formula would give a velocity of about 1375 f. s. When, therefore, it is stated that it would take 2000 f. s., although the weight of projectile is not given, it will be seen what a greatly increased velocity is required for the perforation of a hard-faced plate; a velocity equivalent to the perforation of a homogeneous plate probably of 60 per cent. greater thickness. A large part of this increase is due to the breaking up of the projectile by the hard face. When projectiles, capped or otherwise, are obtained which uniformly perforate

* The article follows.—*Editor.*

the present hard-faced armor plates unbroken and undeformed, this difference will be decreased. 8-inch armor-piercing shell are now being furnished the Navy Department, under contract, which have perforated, unbroken and but little deformed, an 8-inch hard-faced plate when fired with a velocity of 1900 f. s., which is somewhat greater than is required when the shell is unbroken and but little deformed.

If by the development of the shell its efficiency against hard-faced armor becomes equal to that which it attained against homogeneous armor, it is probable that this percentage of increased thickness mentioned above, namely, 60 per cent., would be reduced to 30 or 40 per cent., so that an 8-inch hard-faced plate would be equivalent to an 11-inch oil-tempered plate. If these two plates thus offered exactly the same ballistic resistance to an 8-inch shell, and if we suppose the body and back of the 8-inch hard-faced plate is of the same material as the 11-inch homogeneous plate, it will appear that we are claiming for the hard face of the 8-inch plate, about ¾ inch thick, an effect equal to the front 3¾ inches of an 11-inch plate. Of course the increased strength and hardness of the ¾-inch thickness would not, of itself, be equal to the resistance of 3¾ inches of the homogeneous plate; but its effect on the face of an 8-inch plate is equal to that of the 3¾ inches on the 11-inch plate, principally because it prevents the flow of the metal to the front on impact. The front 3 or 4 inches of an oil-tempered plate offers comparatively but little resistance to the projectile on impact, the section of the point being small, and the metal free to flow to the front around the point of the shell, producing the front bulge and fringe until the perforation reached such a point that the direction of least resistance of the metal is towards the rear. It is by preventing this flow of metal to the front that the hard face on the 8-inch plate enables it, with a thickness of ¾ inch, to contribute to the total ballistic resistance of the plate an amount equal to the 3¾ inches of the homogeneous plate to which it is compared. The dimensions 8 and 11 inches above used are for the sake of illustration, as we do not as yet know what thickness of hard-faced and homogeneous plates would offer the same ballistic resistance under different conditions.

HERR KRUPP ON THE PERFORATION OF STEEL ARMOR.

[Reprinted from London Engineer of J [illegible] 3.

The investigation of the laws of perforating armor [illegible]
ties has not been satisfactorily attempted. Artil[illegible]
tent themselves in all countries with empirical [illegible]
mentary evidence. For this, no doubt, obvi[illegible]
It may be said, first, that the plates often f[illegible]
of work done is changed, and still worse, t[illegible]
trials are very costly and must be con[illegible]
view, and hence isolated results are obtai[illegible]
to the formation of series. The answer to [illegible]
could be investigated on a miniature scale, which w[illegible]
tively little, and so laws might be suggested [illegible]
verification by any trials which might take place [illegible]
believe ourselves that almost all laws on such q[illegible]

lished, and both on this and on the other side of the Atlantic the cry has been raised for something to be attempted, though hitherto without success. So far as we are aware, we all run very much in the same groove, and it is a curious spectacle. At Meppen, in a solemn German manner, is tried year after year how certain individual German plates behave under the attack of big German projectiles which will never be fired at these on service. At Gâvre, French shot make an animated onslaught on French armor. At Portsmouth or Shoeburyness, British projectiles attack British plates. At Indian Head the United States projectiles of Carpenter and Wheeler-Sterling prove their powers on Carnegie and Bethlehem armor. Rarely, indeed, is a plate attacked by any shot representing those which it could in any reasonable likelihood encounter in war. At one time Holtzer's shot were much used and formed a sort of international standard of comparison, but latterly this seems to have dropped out. Russia and some other powers, from ordering armor abroad, have brought the shot and armor of different countries into comparison occasionally; but generally speaking it might be supposed that each nation was mainly interested in isolated facts connected with the attack of her own plates by her own shot, and did not care to obtain more general information, either by experiment or by the establishment of laws and formulæ. In this condition of things, it is curious to note how such individual efforts as are made bring out similar results, though sometimes masked in the different shapes assumed, and by the use of different systems of units. In our issue of April 24th last we pointed out how similar are two formulæ proposed by Krupp and Tresidder, the real difference being that in the former weight tells more than in the latter. It may be seen below that with projectiles of the same weight the formulæ become identical. Thus, written in British units, Krupp's formula is

$$t^{\frac{4}{3}} = \frac{w\, v^2}{d^{\frac{5}{3}}} \times \frac{1}{\log^{-1} 5.7776} \text{ and Tresidder's } t^2 = \frac{w\, v^3}{d} \times \frac{1}{\log^{-1} 8.8410}.$$

We may disregard all the constant factors, or allow them to flow, as it were, into one term, whose value will be determined once for all in practice. Taking Krupp's formula and raising it to the power $\frac{3}{2}$, we get $t^2 = \frac{w^{\frac{3}{2}} v^3}{d^{\frac{5}{2}}} \times$ constant term. Next, supposing we are dealing with shot of similar form, it follows that the weight will be in proportion to the cube of the diameter; that is, for w we may substitute $d^3 \times$ some constant; applying this to Krupp's as we now have it, and to Tressider's, we get in each case $t^2 = d^2 v^3 \times$ some constant; that is, they become identical, the sole difference between them having disappeared.

This is a little remarkable, having probably never been intended, and the two formulæ having looked unlike in their original shape. We have, perhaps, a more striking instance of agreement in the case of a formula recently propounded by Krupp for use with the best and newest steel plates with hardened faces. This is taken from the translation of an article by Captain J. Castner, in *Stahl und Eisen* of April 1st, 1896. In continental units this is given as $p\, v^2 = 5800\, a\, E^2$, where v is the striking velocity in meters, p the weight of projectile in kilos., a the diameter of projectile in cm., and E the thickness of the plate in cm. Turning this into English units and transposing, we get—

$$t^2 = \frac{w\,v^2}{d} \times \left\{ \frac{(0.3937)^3}{2.2046 \times (3.2809)^2 \times 5800} \right\}$$

which worked out by logarithms for a single constant becomes

$$t^2 = \frac{w\,v^2}{d} \times \frac{1}{\log^{-1} 6.3532}.$$

This is said to have been first laid down at the Krupp Works, which may be true as applied to steel with a hardened face, but certainly is the oldest and simplest form of Fairbairn's equation, and the one on which a rule-of-thumb was based many years ago, as explained in the "Official Text-Book on Armor and its Attack," page 30, 31. This rule-of-thumb was then applied to wrought iron, and gave the best results when the sectional density of the shot was such that $\frac{w}{d^3} = 0.41$, and when the striking velocity was not very far removed from 2000 foot-seconds. According to Krupp, we may now take it as based on the best formula that can at present be suggested, and we find the average $\frac{w}{d^3}$ for the six first armor-piercing calibers of Krupp's, which we take is 0.42, while for thirteen British it is 0.45. The striking velocity on service for heavier guns would probably not be very far removed from 2000 foot-seconds; so that a fairly sound rule-of-thumb ought to follow—depending on the constant—and this turns out such that we may say, approximately speaking of steel plates with hardened faces, 2000 foot-seconds striking velocity will give about the caliber perforation, and other velocities proportionately. Thus a 6-in. shot with 2000 foot-seconds may perforate 6-in. treated steel; with 1500 foot-seconds it may perforate 4½-in.; with 1000 it may perforate 3-in., and so on. This amounts to putting the best steel equal to twice the thickness of wrought iron. In the absence of more trustworthy data this may be useful, but we need hardly say that it is only suggested, not at all established. It is possible that the hard-faced armor of the present day may crush less and tear more truly and completely than softer metal, and this suits the old formula, but with armor depending on its power to fracture the shot's point, and with shots at all broken, great elements of uncertainty must exist, and we are brought back to our need of systematic experiment in order to obtain any certainty.

ARMOR-PLATED TORPEDO BOATS.

[THE ENGINEER.]

A consideration of the duties to be discharged by torpedo-boats or torpedo-boat destroyers, and the results obtained in actual practice, lead us to think that far too much importance is being attached to mere speed. The torpedo-boat in all its forms is a compromise, like every other war-ship. We cannot have extreme speeds and several other good things as well; and it is very questionable, we think, if a speed of say 30 knots is worth the price paid for it. In actual service it is very improbable that it will be attained. We need not stop to explain why. The reasons are well known to engineers in the navy, and to most gunnery officers and sailors as well. They concern the quality of the fuel, the skill of the

firemen, the load on board the boat, and the weather, besides certain points connected with the trim of the vessel and the state of the sea. On the whole it is far more likely that a boat which attains 27 knots on her trial trip will give 25 knots on service than it is that a 30-knot boat will give 27 knots at sea. But in any case it does not appear that these extravagant speeds possess any real fighting value, or, at least, not enough to compensate for the sacrifice made to attain them. It is obvious that a torpedo-boat attack made in daylight must be regarded as a forlorn hope. Every man taking part in it knows that the chances are a thousand to one that he will be killed. The difference between 28 knots and 30 knots speed will not augment the chance of escape by a decimal of one per cent. Attacks will almost certainly be made at night, not so much to save the lives of the crews of the torpedo-boats as to give them a chance to destroy the ships attacked. Here again the difference of a knot or two an hour is of no value as a means of safety; nor can it be said that extraordinary speed is necessary in a torpedo-destroyer to enable her to sink torpedo-boats. Under almost all circumstances she must be faster than a torpedo-boat because of her greater size; which will enable her to make better weather than craft of half the tonnage. This fact has been proved over and over again during the naval manœuvres.

Now, other things being equal, the sacrifice of about one knot an hour will enable the builder to protect the whole engine and boiler space with hard steel armor half an inch thick. This will form a very respectable protection. It will not be easy to strike it otherwise than at an angle, and consequently it can defy all the small natures of quick-fire guns, such as the Maxim automatic, and the like. Leaden projectiles will have no effect whatever. Such armor will add enormously to the safety of the crews, and will thereby promote in more ways than one the efficiency of the torpedo-boat, or rather destroyer. The bravest of brave men may well become excited and flurried when they know that they are going away in a craft which may be riddled with rifle bullets. The chance of striking a torpedo-boat with comparatively large projectiles is small; and hitherto ships have trusted mainly to their nets, and to a hail of small shot, so to speak, for the defense. But by enabling the torpedo-boat to defy the small-arm men and the little machine guns, more than one-half the risk of an attack is removed. The attackers may go into action with a prospect of coming out alive; and the fact will give confidence and coolness, and promote efficiency in a very tangible way. Sailors are really just like other men, and we have only to put ourselves in the place of the crew of a torpedo-boat to realize how important and valuable the half-inch of armor may be.

In our own Navy we always follow the lead of some one, we seldom initiate anything; we develope or improve, we do not originate. That is to say, the Lords of the Admiralty are either extremely cautious or excessively conservative. Consequently we have as yet no plated torpedo-boats; but such things are by no means new. Messrs. Yarrow & Co. built for the Japanese Government a boat, the Kotaka, about eleven years ago; all her engine-room and boiler-room space is protected with armor 1 inch thick. This boat did excellent service during the recent war. She is very nearly of the same dimensions as the modern destroyer. We do not know what her speed is, probably about 22 knots, or a little less. That was a high velocity eleven years ago. It seems to have been sufficient to enable her to do what she was expected to do. Messrs. Yarrow

& Co. have just completed and tried a destroyer for the Argentine Government, which is provided with ½-in. steel armor over the engine and boiler-room space. This entails the loss of about three-fourths of a knot per hour. The vessel is the Santa Fé; she is the first of several, and her official trial took place on Thursday week. The trial consisted of a three hours' full-speed run, carrying a load of 35 tons, when a mean speed during the three hours of 26.5 knots was obtained. The dimensions of this vessel are 190 feet in length by 19 ft. 6 inches beam. The vessel is fitted with Yarrow straight-tube boilers, and the speed above named was obtained with 1¼-in. air pressure in the stokehold. The Argentine authorities expressed themselves in every way thoroughly pleased with the result, the speed exceeding by half a knot that contracted for.

Now, we think it can hardly be maintained that the price in the shape of loss of speed paid for this armor is too high. Without the armor she would have made, say, 27.5 knots. Can it be shown that the extra knot would have made her much more efficient? We think not. This question of efficiency must be regarded from two points of view. It is admitted by all naval authorities that the torpedo-boat, or destroyer, is far more likely to do good by frightening an enemy than in any other way. The circumstance that a few torpedo-boats are known to be in a port or harbor will effectually prevent any admiral or captain from attempting to blockade that port at night, whatever he may do in the daytime. He will probably get away to sea as darkness approaches. But it seems to be reasonable that an attack from armored torpedo-boats should appear to be a much more dreadful event than an attack by unarmored boats. Against a night attack much reliance is placed on the "riband of missiles" round a ship. If, however, the attacker can cross the riband with impunity, the danger incurred by the ship is much augmented. An admiral who might dare certain things against an ordinary torpedo-protected port would probably think twice before he risked an onslaught from armored torpedo-boats. This is one aspect of the case, and far more likely to be appreciated at its full value in real life than when stated in print. Another is, that leaving on one side all consideration for the lives of the torpedo-boat crew, it is clear that the longer she can be kept afloat in action the more harm is she likely to do. The argument which we have heard urged against plating such boats is that thin armor of this kind is quite useless against anything but the lightest missiles. We have endeavored to show that it is these lightest missiles which constitute the greatest danger for the torpedo-boat, and even steel projectiles 1 inch in diameter will not find their way through hard plates if they strike at an angle. In any case, the safety of the boat is augmented; the only drawback is a small sacrifice of speed. Those who are opposed to plating have to show that the loss of a knot or two in speed is too large a price to pay for the protection given in its stead.

EXPERIMENTS WITH MODELS AT THE BARROW-IN-FURNESS SHIP-BUILDING YARD.

[ENGINEERING.]

* * * A new departure in the work of design was made at the establishment when the company were asked to construct torpedo-boat destroyers of 27-knot speed, and the system organized by Mr. Adamson is specially

interesting in view of its simplicity and the large measure of success that has been attained—the margin of accuracy comes well within the limits of practical success, and this, after all, is as much as can be said of most technical, as distinguished from laboratory experiments. The system is a modification of that introduced by the late Mr. Froude; but the apparatus is inexpensive, and instead of an inclosed tank, the Devonshire Dock is utilized. The experiments were first made at Barrow in the winter of 1893, under the direction of Mr. George Brown, the assistant chief draughtsman, who has charge of the scientific work in the designing department. The data obtained were embodied in the design of the three 27-knot destroyers then built, and were amply confirmed by actual experience with the vessels when on trial. This success induced the builders to make similar experiments with the model of the later 30-knot destroyers.

The model is run with the assistance of a launch, the speed of the launch and of the model bearing a known relation to the speed of the full-sized vessel, and the mechanism for ascertaining the resistance is placed on the launch. The recording apparatus is illustrated by Figs. 1 and 2. It was, of course, inadvisable to tow the model behind the launch on account of the disturbance in its wake. A long spar or bowsprit was, therefore, rigged over the bow of the launch, the length of the projection being sufficient to keep the after end of the model about 4 feet in advance of the bow of the launch. The model is guided by rods at each end, these rods being free to swing fore and aft, while rigid in an athwartships direction. The rods hang from the spar into fore-and-aft guide slots of hard wood, projecting past the ends of the model. The necessity for these will be apparent to any one who has discovered the impossibility of towing a ship or boat in a straight fore-and-aft line without the help of the rudder or some other means of steering. A model free but for a tow-line fixed to its extreme fore end will, when towed, swerve to one side or the other indifferently, and will travel along in a half-sidelong fashion.

The model is towed at the lower end of a long balanced lever, the connection being a wire link hooked to the lever, and to a bulkhead left in the model when originally hollowed out. The lever, left free to swing round its center in a fore-and-aft vertical plane, is pivoted at its center on the spar, and its upper end is connected to the recording gear by a fine wire cord, which previous to using is thoroughly stretched. Exactly half-way between the center of the lever and its lower end another wire is connected to the lever and led aft over a pulley on the stern of the vessel. From the aft end of this wire is hung a scale pan to which is attached a permanent weight to keep the wires tight and put a slight initial strain on the spring. This helical spring is introduced into the upper wire, and its extension when the model is towed gives a measure of the resistance of the model. The extensions of the spring are recorded on an exaggerated scale on a paper stretched round a drum driven by clockwork. The markings are made by a small pen attached to one end of a light wooden lever, the other end being fastened to the wire immediately forward of the spring. The clockwork is so arranged as to give about one revolution of the drum in the time taken to pass over the measured distance at full speed. To obtain a scale by which to read the extensions of the spring in pounds resistance, weights of known specific gravity are placed in the scale pan at the stem of the model—2 lbs. in the pan being equal in effect on the spring and pen to 1 lb. resistance of the model. By marking on the paper the position of the pen with different weights in the pan a scale of pounds resistance was obtained.

When running, the clock is started, and as soon as the measured distance is reached the pen is lowered on to the paper on the revolving drum, tracing an oscillating line. The oscillations are, of course, partly due to the natural oscillations of the spring and partly to the vibration of the launch and the spar due to the beats of the propelling engines of the launch. The mean of the oscillations, obtained by integrating with planimeter, gives the resistance of the model at that particular speed. The results are plotted in the form of a curve as resistance in pounds in terms of the speed of the model in feet per second. The spots, owing to the causes mentioned later, do not give a fair curve, but by taking plenty of spots, and running a mean curve through, the error is minimized.

The total resistance, of course, combined two elements—surface friction and wave-making—the relations between these two for ship and model following a different law of comparison, and being in different proportions. Froude's experiments give a means of calculating the amount of

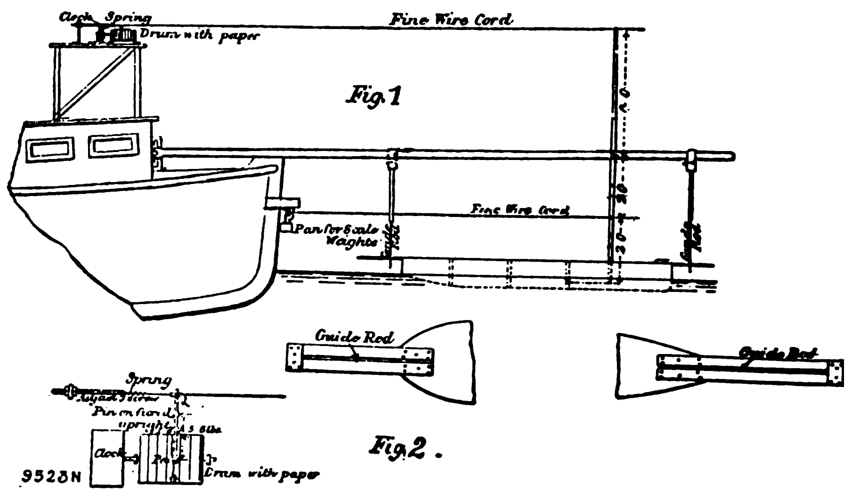

Fig. 1

Fig. 2.

surface friction resistance for both ship and model, the residue of the model's resistance being wave-making, which, for corresponding speeds, varies directly with the displacement, or as the cube of the dimension. Dealing with the two parts separately, the total resistance of the ship is obtained, which, expressed in foot-pounds per minute, gives the effective horse-power or horse-power actually required to drive the vessel at the speed. To this has to be added an allowance for the power lost or otherwise used in driving pumps, overcoming friction, etc., an amount which varies with the type and speed of engine and propellers, but in a case of this kind should not be much more than 40 per cent. of the total indicated horse-power.

It is not contended that the results so arrived at are absolutely correct. With comparatively rough gear in an exposed dock such consistent and steady results were not anticipated as are obtained with the elaborate and delicate machinery in use in covered-in experimental tanks. The

aim was to furnish in the case of such unprecedentedly fast craft some independent and reliable check on the estimates for power, so as to avoid the risk of serious error. As a matter of fact, the results exceeded all expectations, particularly in view of the difficulties, and especially the fact that the model was run in a large dock in which the water is rarely absolutely smooth—a very slight ripple on the dock being, in proportion to the size of the model, a rough sea. It is, perhaps, unnecessary to remark that the experiments were only made in fine calm weather when the dock was as nearly as possible smooth. Again, the fact that no account is taken of the effect of the screw propellers on the vessel's resistance is in itself a serious drawback; but, as we have said, it gives a good independent check on estimates of power for exceptional speeds, and therein is great advantage.

The launch used has a maximum speed of just over 7 knots, which, with a model $\frac{1}{20}$th of the full size—the scale used in the first experiment—corresponds to a speed of 31½ knots for the ship. As it was considered desirable in the case of the faster destroyers to have results up to a speed of about 35 knots, the scale of the new model was made $\frac{1}{24}$th of the full size running at 7 knots, this corresponds to a speed of 34¼ knots for the ship. Better results would probably have been obtained with a larger model, but the size was restricted by the speed of the launch used for towing the model. The speed of the launch was, for want of a better method, measured by the time taken to pass a known distance, marked on the side of the dock in the usual way by two pairs of posts set square off the course. The engines were set to the desired speed some time before reaching the measured course, and not touched until the run was over, so as to have a constant speed on the run.

VISIBILITY OF LIGHTS AT SEA.

A commission appointed by the German Government to study the visibility of lights at sea has concluded from the means of numerous experiments that a white light of 1 candle-power is visible at a distance of 2800 yards on a clear night, and at a distance of 1 mile only on a rainy night. It was further found that when a white light of 1 candle-power was visible at a distance of 1 mile, one of 3 candle-power was visible at 2 miles, of 10 candle-power at 4 miles, and of 19 candle-power at 5 miles. A green light of 1 candle-power is visible at 0.8 of a mile, and the lighting powers of such lights to be seen at distances of 1, 2, 3, and 4 miles must be 2, 15, 51, and 106 candle-power respectively. The best glass is clear blue-green, whilst for the red light a copper-red is, it is stated, the best.

THE PNEUMATIC PAINTER.

[ENGINEER.]

At 86, Charing Cross-road, London, there is on view a new machine for applying paints, enamels, ships' compositions, tars, and other liquids, by means of pneumatic pressure. The machine comprises a closed paint receiver, containing the paint or liquid to be used, into which compressed

air is forced through a tube for the air supply. This causes the paint to be driven along a metallic tube to the nozzle, where it is met by a blast of air which atomizes the paint and projects it in the form of a fine spray. Owing to the pressure with which the paint is applied, it enters into the smallest interstices of metal work, and prevents oxidation in partially concealed parts, which sometimes escape the most careful hand work. A surface of 11,200 square feet was recently painted with two small power machines in 6½ hours, equal to almost 100 square yards per hour for each machine.

OIL ENGINE SIGNALING PLANT ON U. S. LIGHT-SHIP, NO. 42.

[SCIENTIFIC AMERICAN.]

Hitherto it has been the custom to have the whistle on this light-ship blown by steam. This necessitated the use of coal, which involved much expense and trouble. Often great delay would be experienced in the transfer of coal from the tender to the light-ship. An efficiency exceeding four or five pounds of coal to the horse-power hour could not well be looked for. If a fog was seen approaching or forming, the boilers would have to be fired in anticipation, and before they were well started the fog might cease. This and similar conditions of the service involved in the course of a year many hours of idle steaming and many tons waste of coal.

The new plant with oil engines avoids to a great extent these troubles. The consumption of oil per horse-power hour is only one pound. To the great economy directly due to this fact is superadded the feature that no idle steaming is needed. The engine can be started in fifteen minutes, and the oil consumption ceases the instant the engine stops. A quantity of oil very much less than the weight of coal requisite for corresponding service is required.

The plant is a development of one already in successful use on another United States light-ship. In the hull of the vessel are installed two 25 horse-power Hornsby-Akroyd oil engines. These are explosion compression engines whose most distinctive peculiarity is the method of ignition of the charge. Back of the cylinder is a vessel forming a sort of continuation of it and acting as a retort. To start the engine, a powerful oil burner is lighted beneath the retort. In ten or fifteen minutes, for a 25 horse-power engine, the machine can be started. Oil is admitted to the now hot retort. It is at once vaporized, mixes with the air, and, as the engine is started, explodes, giving an impulse to the piston. The regular cycle of the compression gas engine is followed. The retort keeps hot by the heat of the explosions, the lamps being only used to start the engine, and it may even rise to redness; its direct heat effects the ignition. There is no battery and spark coil and no troublesome ignition tube. It is calculated that 15 horse-power can be developed for twelve cents an hour. This power is that approved of by the engineers for light-ship signaling.

The cooling of the cylinder of the engine while running is effected in the usual way by water caused to circulate around it through passages in the metal. Fresh water is employed, as the danger of salt deposits precludes the use of sea water. To avoid waste, the same water is used

over and over again, being cooled by a surface condenser supplied with a constantly changing supply of sea water.

To each engine is connected a single-acting air compressor. The air can be used as fast as compressed to blow the whistle. To make provision for instant use of the whistle, as for a very sudden fog, two tanks of boiler iron, each one twenty feet long and three feet in diameter, are provided, which are charged with compressed air by the compressors. Ten cents' worth of oil will charge the tanks to their full capacity at 60 pounds to the square inch. The air contained is sufficient to keep the signal whistle in operation for twenty minutes. This period gives ample time to start the engine, so there should never be any delay in getting the whistle in operation.

The expansion of compressed air produces a lowering of temperature, which reduces the volume of the air. As the work done depends on the volume, the diminishing of it involves a loss in efficiency. The whistle, which is of the bell type, and which is placed about amidship over a deck-house, has beneath it a reheater through which the air must pass. The exhaust from the engine passes through the same reheater, and so raises the temperature of the air and overcomes, to a greater or less extent, the cooling of the air due to its escape from compression. This feature not only is of economical value as utilizing the waste heat of the engine, but it tends to overcome another trouble. It has been found that an air whistle when the temperature fell to 18° F. would become clogged with ice. The heating of the air tends to prevent this. Moreover, the exhaust escapes into the air just forward of the whistle, and will do much to keep it warm and in condition to operate well.

Before reaching the whistle the air passes through a reducing valve, then through the reheater and then through the whistle valve. The latter regulates the admission of air so as to produce the characteristic signal, and is operated by clockwork. The latter operates a small valve which admits air into a cylinder with piston, which opens the whistle valve. When released by the clockwork it falls and closes the whistle valve. The clock carries a cam which, by its shape, produces the desired order of opening and closing the valve so as to give the signal. The officially designated fog signal for this ship has been a 12-inch steam whistle, with blasts of five seconds duration, followed by fifty-five seconds of silence. The air whistle is slightly modified, its annular opening for the escape of air being smaller than in the case of the steam whistle.

The engines' air compressors and storage tanks are exact duplicates of each other and are interconnected so as to allow the fullest possible degree of interconnection. It is quite improbable that any total break-down should occur. The oil is stowed away as received in five-gallon cans. The engine supply is taken from a tank below the engines, into which the cans are emptied by hand.

A NEW FINDING LIGHT FOR WAR VESSELS.

[ELECTRICAL ENGINEER.]

The French Mediterranean squadron has just made an interesting experiment with a novel light, the invention of a French naval officer. The sailors call it "the rat-trap light." The squadron left Marseilles on the 20th of August, at 5 o'clock in the evening, leaving behind the torpedo-

destroyer Faucon, which was to start 3 hours later and hunt it up. At 8 o'clock the Faucon weighed anchor and steamed out in pursuit with all lights extinguished except this novel affair, the *ratière*. Nobody on board knew the direction the squadron took, but at 1 o'clock in the morning the Faucon joined it.

The "rat-trap light" is a thing of small dimensions placed in the stern of the vessel above the wheel. No other light is permitted on board. It throws out an electric light which cannot be seen on the right or left of the ship, and can only be discovered dead ahead under certain conditions known to the seeker. By means of this invention night signals can be made when rockets or flash-lights might be useless or liable to betray the position of the fleet to the enemy. It can also guide a squadron in line, with all other lights out, even in dangerous latitudes.

The French Navy alone possesses this light, and the Admiralty evidently attaches great importance to it, judging by the precautions that are taken to guard it against discovery. The commander of the ship and one sworn officer alone handle it, and it is kept on board in a special apartment, of which the commander holds the key.

SMOKELESS POWDER IN WAR.

[Army and Navy Journal.]

Military Information Division, No. 9, contains an article on "Smokeless Powder: Its Influence on Tactics." We are told that the advantage which cannot be denied in smokeless powder is that it will facilitate the control of officers in command of units; before, when all was enveloped in smoke, they could neither see the enemy nor their own men. Now this will not happen. By means of signals they will be enabled to make themselves understood by their subordinates; they will not stumble unexpectedly upon obstacles which smoke concealed, and will find it less difficult to keep in touch with collateral units whose movements can be seen. Smokeless powder will give a clear field of fire, but there must always remain the difficulty of accurately judging distances, and, above all, the fact that the number of soldiers who shoot well is very small, the majority not even taking aim.

It is not believed that the use of the new powder will render necessary any essential modifications in the tactics of small bodies, and as the supporting line loses the protection of smoke its position will become more precarious. In the future, as in the past, there will be only one way of deciding a battle, viz., to get to your enemy, or at least close enough to convince him that you have sufficient power to drive him from his position. The influence of smokeless powder with artillery will, perhaps, be greater than with infantry, since this arm generally fights at a distance, is more under the control of its officers, and is less demoralized by an enemy's fire; as a consequence it can take fuller advantage of scientific improvements. In certain countries and climates it will allow greater freedom in the use of artillery, and will enable fire to be opened indifferently from either flank. It will, besides, permit of guns being placed in tiers, since with the ordinary powder the smoke which the lower batteries produced on rising formed a cloud in front of the higher. Moreover, in the absence of smoke, which disclosed the position of guns and inter-

fered with their service, they may in certain cases, without inconvenience, be placed at intervals of five or six yards only, so reducing the front of a battery to thirty or forty yards. Smokeless powder will more frequently permit the use of artillery *en masse*, because (a) it is easier to find positions, (b) the intervals between the guns can be reduced, and (c) there is no smoke to cause the difficulties already referred to. The unity of command is facilitated, and with it the concentration of the guns.

So far from smokeless powder rendering cavalry valueless on the battlefield, it will not seriously modify the conditions of its use. At first sight, indeed, the attack of infantry by cavalry, unprotected by smoke, appears a folly; but the rapidity with which cavalry moves makes it a difficult target. Furthermore, smoke prevented the infantry from seeing its approach. This will not now happen, and the sight of cavalry advancing at great speed may of itself be sufficient to cause a panic among infantry which is already on the point of giving way.

These are the opinions of R. J. Byford Mair, Lieutenant Royal Engineers, who says in conclusion: "We are of the opinion that the use of smokeless powder will not necessitate the introduction of radical modifications in the tactics of the three arms. As a German writer says, 'Every advantage of the new powder is so evenly balanced by some disadvantage, and each disadvantage appears so small by reason of the attendant advantages, that the future will not differ from the past in any important point.' It will exact stricter discipline in armies and increase the probabilities of success for the side which is braver, better instructed, and more skillfully led. More than ever, victory will be gained by those most worthy of it."

SPECIFICATIONS FOR SMOKELESS POWDER.

[ARMY AND NAVY JOURNAL.]

Specifications issued by the Army Ordnance Department for smokeless powder for the Krag-Jörgensen 0.30 caliber rifle require that it should show a mean velocity at fifty-three feet from the muzzle of not less than 1960 foot-seconds, and the mean variations of velocity must not exceed 20 foot-seconds, and the maximum pressure 38,000 pounds per square inch. The powder pulverized or subdivided into minute grains must withstand for at least fifteen minutes a temperature of 150° to 154° Fahrenheit without emitting acid vapors, as indicated by the slightest discoloration of a piece of iodide of potassium starch paper partially moistened with dilute glycerin.

The powder must also be proof against tests for moisture, dryness, and cold.

The powder must be uniform in quality, free from dust and other foreign substances. Other qualities, in regard to which such additional tests will be made as the Department may deem necessary, are required as follows: The powder must be practically smokeless; must not corrode the barrel or cartridge case, nor require an unduly strong primer for ignition. It must not leave a hard adherent residue in the bore, especially after rapid firing, nor a metallic residue due to action of heat on bullet or barrel.

It must not be sensitive to friction or shock, and must not be so friable as to endanger breakage of grains in transportation incident to service.

It must not contain ingredients known to be unsuited to form a safe and reasonably stable compound, and must admit of machine loading with the machines in use or that can be readily provided at the Frankford Arsenal, not exceeding a variation of 0.3 of a grain from the desired charge in fifty consecutive machine-loaded charges.

It must not show a tendency to agglomeration during storage. Powder which may be found defective in this respect, and which has not already been used in the manufacture of cartridges, will be returned to the makers at their expense, and deliveries of the powder under contract will be suspended. Other things being equal, that powder which produces the least heating of the barrel will be preferred.

SHOOTING UNDER WATER.

[INVENTION.]

The most curious experiment ever made with a piece of ordnance was at Portsmouth, England. A stage was erected in the harbor within the tide mark; on this an Armstrong gun of the 110-pound pattern was mounted. The gun was then loaded and carefully aimed at a target—all this, of course, during the time of low tide. A few hours after, when the gun and the target were both covered with water to a depth of six feet, the gun was fired by means of electricity. We said "aimed at a target," but the facts are that there were two targets, but only one was erected for this special experiment, the other being the hull of an old vessel, the Griper, which lay directly behind the target and in range of the ball. The target itself was placed only 25 feet from the muzzle of the gun. It was composed of oak beams and planks, and was 21 inches thick. In order to make the old Griper invulnerable, a sheet of boiler plates three inches thick was riveted to the water-logged hull, in direct range with the course the ball was expected to take if not deflected by the water. On all of these—the oaken target, the boiler plates, and the old vessel's hull—the effect of the shot from the submerged gun was really startling. The wooden target was pierced through and through, the boiler iron target was broken into pieces and driven into its "backing," the ball passing right on through both sides of the vessel, making a huge hole through which the water poured in torrents. Taken altogether, the experiment was an entire success, demonstrating, as it did, the feasibility of placing submerged guns in harbors in time of war and doing great damage to the vessels which an enemy might dispatch to such points for the purpose of shelling cities.

THE LARGEST SHIP IN THE WORLD.

[SCIENTIFIC AMERIC

According to Prometheus, the largest ship the
the Vulcan shipyard in Bredon, near Stettin,
American line. The same builders constr
steamer built in Germany, the Augusta-Victor
new monster steamer has a length of 628 feet
therefore considerably larger than the Campania,

between perpendiculars. The engines will have 27,000 horse-power and a speed of 22 knots is expected. The engines and boilers will also be furnished by the Vulcan shipyards. Construction has been commenced already.

THE ST. PAUL.

The American Line s. s. St. Paul arrived at Sandy Hook on August 14, in 6 days 31 minutes from Southampton. The course covered was 3046 knots, and the mean speed 21.08 knots per hour. The best day's run was on August 13, when 530.8 knots were covered. The coal burnt was 315 tons per day. The record of the Hamburg-American ship Fürst Bismarck for the same trip was 6 days 9 hours 43 minutes. The White Star steamer Britannic has also lowered her previous best record made 19 years ago with a passage of 7 days 7 hours 31 minutes.

SHIPS OF WAR AND NAVAL NOTES.

[THE UNITED STATES.]

SPEED TRIALS OF THE BROOKLYN.

The new armored cruiser Brooklyn on her builders' trial attained a speed closely approximating 21 knots, or about 20.97. The trial was made over the Government official trial course, from off Cape Ann, Mass., to a point off Cape Porpoise, Maine, and back. The measured distance between the two capes is 41½ knots, thus making a full run of 83 knots. The outward run to Cape Porpoise was covered at an average speed of 20.66 knots, and the average on the return trip to Cape Ann was estimated at 21.28 knots. This gives a general average of the full run of 20.97 knots per hour. The engines are said to have worked admirably at all stages of the trip.

On Thursday, August 27, the Brooklyn underwent her official trial over the same course and eclipsed her first performance by nearly a full knot an hour, proving herself one of the fastest vessels of her class afloat. The vessel covered the 83-mile course at an average speed, allowing for tide, of 21.9117 knots an hour. For 7 knots on the return trip her speed rose as high as 22.9 knots.

The official report of the board appointed to conduct the trial contains these general conclusions:

That the vessel is sufficiently strong to carry her armor and the armament equipment, coal, stores and machinery prescribed by the Secretary of the Navy and indicated in the drawings, plans and specifications.

That the vessel is in all respects complete and ready for delivery in accordance with the requirements of the contract, except as to several items, the most important of which relate to ordnance equipments. The steering gear worked well, and the vessel exhibited good tactical qualities. The time of putting the helm hard over from amidship thirty-five degrees was fifteen seconds, and from hard over one way to hard over the other way, sixty-five degrees, was twenty-three seconds. The angle of keel was five degrees.

The time occupied in making the total run of 41.5 knots north is given as 1 hour 52 minutes and 26.34 seconds, and the 83 knots running south 3 hours 47 minutes and 8.86 seconds. The tidal corrections to the trial course made the distance through the water 82.9530 knots, and the time mean speed of the Brooklyn 21.9117. During the first run the maximum revolutions of the starboard engine were 138; port, 139; average revolutions, 136.4 for starboard; port, 137.2. For the second run the maximum revolutions of the starboard engine were 138.06; port, 140; average revolutions, 136 starboard, 136.5 port.

The builders, the Cramps of Philadelphia, earn a bonus of $350,000 under the terms of the contract. The Brooklyn is the last vessel to be built under the system of bonuses.

The twin screw cruiser Brooklyn was authorized in the act of Congress approved July 19, 1892, and has been built as an improvement on the designs of the New York. Her principal dimensions are: Length on the load water-line, 400 feet 6 inches; extreme breadth, 64 feet 8¼ inches; mean draft, 24 feet; displacement, 9271 tons. Her maximum indicated horse-power is given as 16,000; the tons per inch of immersion at normal draft and displacement at 41.19; normal coal supply, 900 tons, and bunker capacity, 1753 tons. Her maximum draft aft at lowest point of the keel, when she is ready for sea and all bunkers are filled, will be 26 feet 2 inches. Her engines are of the vertical triple expansion type, and four in number, two on each shaft, and in four compartments. The forward engines are so built as to be readily uncoupled from the after engines, to permit of cruising at low speed. The boilers are placed in three compartments, and are seven in number. Five of them are of the double-ended and two of the single-ended type. The hull is of steel, not sheathed. There is a double bottom, and close, water-tight subdivisions to about 12 feet above the water-line. The arrangement of the decks above water is such as to provide ample freeboard and berthing accommodations. The ship will have two military masts with fighting tops. She will have no sail power. Protection of the hull is afforded by a steel protective deck, worked from stem to stern, and supported by heavy beams. The bottom edges of this deck amidships are 5 feet 6 inches below the 24-foot water-line, the top of the deck rising to this line at the center of the vessel. On the slopes of the deck, over the machinery and boilers, the armor is 6 inches thick; on the horizontal portion, 3 inches thick. Forward and abaft the machinery and boilers, to stem and to stern, the deck at the thinnest part is 2½ inches thick. Below the deck are placed the propelling machinery, steering gear, magazines, shell rooms and all that is known as the "vitals" of a war-ship. An armor belt 3 inches in thickness provides protection for the machinery and boilers. This belt extends from 4 feet above the water-line to 4 feet 3 inches below it. Within the 3-inch armor belt and the skin plating a band of cellulose 3½ feet wide has been worked. This will extend the whole length of the ship in depth from the armor deck to the berth deck. Coal will be carried above the armor deck for a length corresponding to the inner bottom. This space, between the armor deck and the deck above, is subdivided by water-tight bulkheads into 38 coal bunkers. These are exclusive of cofferdams and passages. The space forward and abaft the bunkers has been subdivided by water-tight bulkheads for stores. A conning tower 8 inches in thickness will be carried in a suitable commanding position forward. It will contain a tube 5 inches thick running to the protective deck. This tube will afford protection to the speaking tubes, bell wires, etc.

The battery will comprise eight 8-inch guns, twelve 5-inch rapid-fire guns, twelve 6-pounder rapid-fire guns, four 1-pounder rapid-fire guns and four machine guns. The 8-inch guns will be mounted in four barbette turrets, placed one forward and one aft on the center line of the vessel and one on either side amidships. The guns in the forward and after turrets are to have a train of 310 degrees. Those in the side turrets can fire right ahead to right astern, or to train through an arc of 180 degrees. The center of the side turrets is distant from the center lines of the vessel about 23 feet. The armor forming the barbettes, which will protect the carriages, platforms and turret machinery, is 8 inches in thickness for a portion at least equivalent to the train of the guns of the respective turrets. The remaining portions will be about 4 inches in thickness. Under the turrets is to be found 3-inch armor supporting the tubes, which will also support the ammunition hoists. The armor of the turrets is 5½ inches in thickness. The guns are so mounted that they can be supplied with ammunition and loaded in any position of train. The 5½-inch guns are protected by fixed segmental shields 5 inches in thickness. The crews of these guns are to be further protected from explosive shells by splinter bulkheads 1½ inches in thickness. Protection is afforded the smaller guns by shields and extra side plating. The Brooklyn's torpedo outfit consists of five torpedo-tubes, one in the bow and two on each side. Six torpedoes and a suitable allowance of gun-cotton for mines and miscellaneous purposes will be carried on board.

The contract price for the Brooklyn, exclusive of armor and armament, was $2,986,000. Her keel was laid on August 3, 1893, and under the original agreement she was to have been ready by February 11, 1896, but slow delivery of armor in the earlier stages of her construction delayed the completion of the vessel.

Bids for Battle-ships.

[Iron Age.]

Bids were opened September 14 at the Navy Department in Washington for the construction of the three powerful sea-going coast-line battle-ships provided for by act of Congress approved June 10 last. By this act the cost of the vessels, exclusive of armament, was limited to not more than $3,750,000, and one of the vessels was to be built on the Pacific Coast, provided a reasonable bid was received. Congress specifically stipulated that the award be made and contracts signed by October 8. The following bids were received:

John H. Dialogue & Sons, Camden, N. J., one battle-ship for $2,661,000.

Bath Iron Works, Bath, Maine, one battle-ship for $2,680,000.

Newport News Shipbuilding & Dry Dock Company, Newport News, Va., one battle-ship for $2,595,000.

Union Iron Works of San Francisco, one battle-ship for $2,674,950.

William Cramp & Sons' Ship & Engine Company, Philadelphia, one battle-ship for $2,650,000; two battle-ships for $2,650,000 each.

This means that the Cramps of Philadelphia, the Newport News Company and the Union Iron Works of San Francisco will each receive a contract for one battle-ship. The award to the San Francisco firm, whose bid is slightly in excess of those of John Dialogue & Sons of Camden, and of the Cramps, will be made on account of a difference of 4 per cent. allowed in favor of Pacific Coast bidders to cover cost of transportation

of materials across the continent. This allowance would, for purposes of comparison, bring the San Francisco bid down to $2.598,982, or within $4000 of the lowest bid and considerably under that of the Cramps. The closeness of the various bids and the fact that they were all more than $1,000,000 under the margin allowed was a noticeable fact, showing that figuring on the cost of the work had been very exact.

It was rumored just before the bids were opened that several of them would contain the stipulation that the proposal was made only in case the Government would enter into an agreement to pay in gold, but on examination none were found to contain any such clause. All the companies pledged themselves to give bond in a penal sum equal to 15 per cent. of their bid, and each bid was accompanied by certified checks which, when taken in charge by Judge Advocate-General Lemly, were found to aggregate $460,000. In comparison with the prices secured for the battle-ships Kearsarge and Kentucky, which are now being built at Newport News for $2,250,000 each, the bids to-day show a slight increase. The bids for these two ships, however, were characterized by a wide diversity, and the exceedingly low estimates of the successful bidders, the Newport News Company, caused considerable surprise at the time. The rise in the price of coal in the interval also accounts in a measure for the slight increase in the present bids.

The three new battle-ships are to be combinations of the best features of the Iowa and the Kearsarge types, with sundry improvements. Their general dimensions and principal features are as follows: Length on water-line, 368 feet; beam, extreme, 72 feet 2.5 inches; freeboard, forward, 19 feet 6.9 inches; freeboard, aft, 13 feet 6 inches; normal displacement, 11,525 tons; mean draft, normal displacement, 23 feet 6 inches; indicated horse-power (estimated), 10,000; speed in knots an hour (estimated), 16 knots; normal coal supply, 800 tons; total bunk capacity, 1200 tons.

No premiums are offered for increased speed, but a penalty at the rate of $25,000 a quarter knot is imposed for the first half knot below the maximum requirement of 16 knots. It is proposed to name these ships California, Alabama, and Pennsylvania.

Torpedo-boat No. 6.

Torpedo-boat No. 6, the first of the high-speed torpedo craft authorized for the Navy, was launched September 9 from the works of the Herreshoffs, at Bristol, R. I. In view of the launching the Secretary was cabled on Tuesday for instructions. In his response he directed that the vessel be christened Torpedo-boat No. 6. The officials at the Department interpret this to mean that the Secretary has finally decided to designate all future torpedo-boats by numbers. If all the torpedo-boats for which bids are soon to be opened are built, there will be twenty-one vessels of this class on the Navy ship list, of which, according to the new programme, only three will have names—the Cushing, Ericsson, and Stiletto.

The New Torpedo-Boats.

[Iron Age.]

In the present appropriation for the Navy provision is made for the construction of three torpedo-boats to cost in all not over $800,000, and for the construction of not more than ten other torpedo-boats with a total

cost limit of $500,000. The boats are to be throughout of domestic manufacture, and no premium is offered for excess of speed. The contracts for the construction of these boats must be made on or before the 8th of October, 1896. The three boats first mentioned are to have a speed of 30 knots an hour and to maintain an average of the same for that period under condition to be prescribed by the Secretary of the Navy. Bids for these boats are invited upon plans to be submitted by the builder, including the engines as well, and the contract price is to include the boats complete in all respects, excepting sea stores and ordnance and ordnance outfit of all kinds. Omitting the necessary dimensions of rapid-fire 6-pounder and 1-pounder guns and torpedo discharges, together with weights and sizes of ammunition cases, the bidder is unhampered in every particular, and to his judgment and designing skill is left the planning of these craft. There will be two conning towers, one forward and one aft, in convenient positions; and accommodations will be provided for four commissioned officers and an adequate crew. The boats will be lighted by electricity, but there will be no search-lights.

The exact number, size and speed of the smaller boats not being fixed in the act of Congress, the Department will entertain bids for boats of two separate types, provided always that the total cost of these boats, including ordnance supplied by the Government, does not exceed $500,000. Type No. 1 requires an average speed of not less than 20 knots, to be maintained for two consecutive hours. They will have two conning towers, or sighting hoods, placed in convenient places forward and aft. The freeboard forward to be not less than 4 feet 3 inches; and accommodations must be provided for two officers and an adequate crew. The coal capacity must be at least 16 tons.

The following approximate dimensions are given: Length on load line, 105 feet; beam on load line, 12½ feet; mean draft, 4½ feet; displacement, about 68 tons; indicated horse-power, about 850; speed per hour, 20 knots. Armament: Two single deck torpedo guns, one 1-pounder rapid-fire gun, two automobile torpedoes; 180 rounds 1-pounder ammunition.

If the speed fall below 20 knots an hour, and exceed 19 knots, the boat will be accepted at a reduced price. If below that, acceptance at a lower price will be in the discretion of the Secretary.

Type No. 2 requires an average speed of 22½ knots an hour, to be maintained for two consecutive hours.

The following approximate dimensions are given: Length on load line, 140 feet; beam on load line, 14½ feet; mean draft, 4¾ feet; displacement, about 105 tons; indicated horse-power, about 1700; speed an hour, 22½ knots. Armament: Three single deck torpedo guns, three 1-pounder rapid-fire guns, four automobile torpedoes, 540 rounds 1-pounder ammunition.

If the boat attains a speed of 21½ knots she will be accepted at a reduced price. If the speed fall below that the boat may, at the discretion of the Department, be rejected, or accepted at a reduced price.

[NEW YORK HERALD.]

It is virtually assured that the contracts for the new 30-knot torpedo-boats will be awarded one each to the Union Iron Works, of San Francisco; the Bath Iron Works, of Bath, Me., and the Herreshoff Manufacturing Company, of Bristol, R. I. The two last named companies submitted plans for boats of each class, but the Union Iron Works bid only for the

30-knot boats, presenting plans of a craft of 273 tons, to be constructed in accordance with the ideas of the Department, for $227,500.

The Bath Iron Works people propose to turn out a vessel of 230 tons, and are willing to furnish a guarantee for a speed of 30½ knots, or pay a forfeit of $10,000 per knot. Their price is $235,000.

The awards for the ten smaller craft of 20, 22 and 22½ knots' speed are likely to be divided among the Providence Steam Engine Company, the Charles Hillman Ship and Engine Company, Philadelphia; Wolff & Sewicker, Portland, Ore.; Lewis Nixon, Elizabeth, N. J.; Moran Brothers, Seattle, Wash., and the Columbia Iron Works, Baltimore, all these companies having submitted satisfactory proposals.

Manœuvres of the North Atlantic Fleet

[Army and Navy Journal, and Register.]

Under date of the 27th of July, Admiral Bunce has issued to the North Atlantic Fleet the following circular letter in relation to coming evolutions and exercises of the fleet:

Flagship New York, First Rate,
Navy Yard, New York, July 27, 1896.

GENERAL INSTRUCTIONS.

1. Attention is called to Squadron Circular Letter No. 24, December 28, 1895.

2. To insure ships keeping position, the movement of the guide must be constantly observed. Helm and engines must be moved promptly to regain proper position. Ships must not lag behind. The speed cone should be moved promptly to indicate the action of the engines.

3. No officer should be satisfied with anything less than absolute exactness of position.

4. The line of bearing for alignments will pass through the foremasts of ships.

5. In case of separation by reason of weather or accident to motive power, ships will rejoin the squadron at the port to which it is proceeding.

6. Boards, in accordance with Squadron Circular Letter No. 7, Sept. 22, 1895, will be organized. Suggestions as to any change in the manner of performing the different evolutions, and as to the organization and disposition of the different elements of a fleet are especially desired. Reports in accordance with Squadron Circular Letter No. 56 will be made on the forms furnished, and will be submitted to the commander-in-chief with such suggestions and criticisms as commanding officers may desire to make. These reports will be submitted on the fourth day after arrival in port. The text of the signal will be stated in the reports.

PROGRAM OF SQUADRON EXERCISES.

(a) Swing ship for compass error.

(b) Determine turning circles by sections in accordance with squadron instructions. Ships whose circles have been determined for the designated speeds will not be required to take them again.

(c) Preliminary drills will follow generally the order and sequence of the program of section exercises of June 15, 1896, a copy of which is inclosed.

(d) Regulating the speeds of the engines. The squadron will steam in line or column at different standard speeds. Ships will regulate their speed by that of the flagship, noting the revolutions required under the existing conditions of wind and sea to do so as a standard, subject to alterations, which a change of this condition may make necessary.

(e) Sound signals. Attention is called to the rules for these signals in the introduction to the General Signal Book. In compound formations the signal will be repeated to the nearest ship, taken up by the next ship to her in the formation, etc. Example: In double line No. 4 will be followed by No. 8, then No. 7, etc.

[Then follow the signal numbers to be used for various formations and evolutions.]

(l) In every formation the squadron will be exercised in changing direction or front and in changing course simultaneously or in succession.

The squadron will be exercised also in echelon formations, single and double, and in section formations.

Exercise at general quarters, fire quarters, collision drill, both day and night; clearing ship for action and man overboard.

Sub-caliber and torpedo practice at stationary and moving targets.

Target practice with main and secondary battery—moving or stationary target.

Squadron Circular Letter No. 24, referred to in the order, prescribes certain rules regarding the execution of manœuvres. Circular Letter No. 7 provides that a board of three line officers shall be appointed on board each ship to observe carefully all evolutions and note difficulties or defects in methods. Circular Letter No. 56 says that the time required to execute every evolution shall be recorded, with the helm angle and other observations, so that the records may show when a manœuvre is impracticable or clumsy, and which one of two or more methods is the best.

The vessels of the North Atlantic Squadron, under Adml. Bunce, which left the port of New York on Aug. 1, for evolutions at sea, returned on Aug. 23, and anchored off Tompkinsville, S. I., the fleet being increased by the addition of the Texas and Maine, the ram Katahdin and the monitor Terror, the fleet taking part in the reception of Li Hung Chang. The squadron, after it steamed down the coast on Aug. 1, spent nine days in naval tactics and signaling with flags and whistles, and at night with the electric system of incandescent bulb lights. The ships put into Hampton Roads and coaled, and on Aug. 15 sailed for New York. On the way up they indulged in squadron evolutions and target practice. The capabilities of the ships and their officers were tested thoroughly in three days of hard drilling. The manœuvring, it is said, was accomplished without the slightest hitch. During the practice firing the concussion aboard the battle-ships Indiana and Massachusetts is described by their officers and men as terrific. The target was about twenty-five feet high and fifteen feet wide at the base. The vessels of the squadron passed and repassed it at a distance of 2000 yards, running about eleven knots. The New York led the column, and, as she got in range, she blazed away with her forward battery, following it up with a cannonade from her waist, and finally from the guns of her after division. In the firing the Raleigh, it is reported, won the honors, demolishing the target early in her firing. When the Indiana steamed up within firing range of the target and began to shoot, her 2000-pound anchor, unbent from the cable, was blown from the port bow and thirty feet into the air by the mighty

shock caused by the discharge of the 13-inch gun fired ahead. In the torpedo practice, buoys were placed a short ship's length apart, and, at a speed of six, nine and eleven knots, each ship fired her torpedoes. The target was 400 yards from the ships, and each ship had three shots at it. Every torpedo, it is said, would have hit an ordinary war vessel. After the torpedo firing the squadron steamed slowly northward, indulging in squadron drill until near Sandy Hook.

[NEW YORK HERALD.]

The target practice, each ship steaming past the target at a speed of nine knots and firing as rapidly as possible consistent with good aim, was an innovation that gave officers and men some conception, at least, of the conditions of actual battle, as far as the service of the guns was concerned. In some cases the rapidity of fire was much greater than had been anticipated, and this fact has led to an investigation of the ammunition supply of the different ships to ascertain how long they could keep up such a fire before the full allowance of ammunition stowed in their magazines would be exhausted.

The following table has been prepared from the data furnished by this practical rapid-fire test:

ENDURANCE OF SHIPS IN ACTION.

No. of guns.	Caliber.	No. of shots fired.	Time.	No. per minute.	Weight of metal per minute.	No. of shots per gun per 10 minutes.	Allowance of ammunition.	Endurance.
	NEW YORK.		m. s.		lbs.			h. m.
6	8-in. rifle	17	20 00	.85	212.50	2.84	600	7 02
12	4-in. rapid-fire guns	263	20 00	13.20	435.60	22 00	1800	2 16
8	6-pounder rapid-fire guns	381	19 00	20.00	120 00	50.00	4004	3 20
2	1-pounder rapid-fire guns	123	19 00	4.30	4.30	43.00	2400	9 18
	NEWARK.							
12	6-in. rifles	39	21 00	1.85	185.00	3.08	1095	9 52
4	6-pounders,						1991	
4	3-pounders,	265	18 00	14.50	58.10	29.00	2000	7 35
2	37 mm.						2595	
	RALEIGH.							
1	6-in. rifle	6	10 40	.56	56.00	5.60	148	4 24
10	5-in. rapid-fire guns	207	18 55	11.50	575 00	23.00	1066	1 31
8	6-pounder rapid-fire guns	382	17 51	21 50	129.00	53.75	4004	3 06
2	1-pounder rapid-fire guns	263	17 51	14 50	14.50	145.00	2400	2 46
	INDIANA.							
4	13-in. rifles	8	23 00	.34	374.00	1.70	240	5 53
8	8-in. rifles	17	23 00	.75	187.50	2.00	560	11 40
4	6-in. rifles	13	23 00	.60	60.00	6.00	280	3 53
20	6-pounders	954	22 37	42.30	253.80	42.30	5000	1 58
6	1-pounders	146	22 37	6.50	6.50	21.70	1800	4 37
	COLUMBIA.							
1	8-in. rifle	3	9 17	.33	83 30	3.27	145	7 23
2	6-in. rifle	6	15 40	.41	41 00	4.10	235	9 33
8	4-in. rapid-fire guns	40	15 40	2.70	16.20	6.75	1250	7 43
12	6-pounders	361	12 00	30.00	30.00	50.00	6006	3 20
4	1-pounders	123	12 00	10.25	10.25	51.25	2400	3 54
	CINCINNATI.							
1	6-in. rifle	6	10 00	.60	60.00	6.00	133	3 41
10	5 in. rapid-fire guns	174	19 00	9.10	455.00	18.20	2004	1 50
8	6-pounders	583	19 45	29.00	174.00	72.50	4004	2 18
2	1-pounders	58	19 45	3.00	3.00	30 00	1200	6 40

Note.—Pivot guns were fired only one side.

The table is not intended to show the relative merits of the different crews, and could not be used to make such a comparison, except in the matter of rapidity of fire in the case of ships of the same class, with guns mounted and controlled in the same manner; but it gives some idea of the time during which guns of different caliber on board each ship could be kept in action at a range between 2200 and 1500 yards, firing rapidly, with the present allowance of ammunition.

For instance, the six 8-inch guns of the New York could fight for seven hours and two minutes, her twelve 4-inch guns for two hours and sixteen minutes, and her eight 6-pounders for three hours and twenty minutes. In this case the guns of heavy caliber could be kept in action longer, with the present ammunition supply, than the guns of small caliber. And this would seem to be right, because the heavy guns would begin the action at long range and be called upon before the smaller pieces would become effective.

But in the case of other ships this condition does not exist, and this fact suggests the necessity for readjusting the allowance of ammunition for ships in accordance with some sound rule. For instance, the ten 5-inch guns of the Raleigh, which constitute her main battery, would exhaust all their ammunition in the short space of one hour and thirty-one minutes, while her 6-pounders could maintain their fire twice as long. It is rather startling to find that a ship which keeps up a powerful, rapid and well-directed fire upon an enemy may be helpless for lack of ammunition in so short a time. If the gun is to win in future battles at sea—as all authorities now contend—it must have an ample allowance of ammunition.

In the case of ships on foreign stations, or far from their base, the question is a serious one. It would seem that there must be ammunition supply ships, as well as store ships and colliers, for the service of a modern fleet if the latter is to be prepared to fight more than one battle, or even one. So much space has been given to engines, and so little to coal, that it is hardly possible to increase the ammunition supply by using a coal bunker for that purpose, except in the case of ships on the home coast. This is another unfortunate result of the craze for speed—speed that would not, and could not, be used in actual battle. It has in some cases robbed ships of the guns and the space for the ammunition that would be used. The emergency of battle has not always been properly considered in designing ships of war. In many cases the ability to run has been secured at the expense of the ability to fight.

Comparing the endurance of the Newark and the Raleigh, the former firing thirty-nine heavy projectiles in twenty-one minutes and the latter 213 heavy projectiles in nineteen minutes with her more modern rapid-firing guns, it will be seen that we have vastly increased the offensive power of the battery in recent ships without providing sufficient endurance. It may be said that there is less necessity for great endurance with rapid-firing guns than with those that fire slowly, because battles may be proportionally shorter; but still, we should get a reasonable endurance, and one and one-half hours is not enough.

Another table, compiled from data furnished by the same battle practice, shows the total weight of metal actually thrown by each ship in ten minutes from one broadside:

EFFICIENCY OF SHIPS IN ACTION.

Caliber of gun.	Main Battery. No. of shots.	Main Battery. Weight of metal.	Main Battery. Total.	Caliber of gun.	Secondary Battery. No. of shots.	Secondary Battery. Weight of metal.	Secondary Battery. Total.	Grand Total.
		lbs.	lbs.			lbs.	lbs.	lbs.
NEW YORK.				NEW YORK.				
8-inch rifles	14.20	3,550	7,906	6-pounder	200	1,200	1,243	9,149
4-inch rapid-fire guns.	132.00	4,356		1-pounder	43	43		
NEWARK.				NEWARK.				
6-inch rifles..	18.00	1,800	1,800	6-pounder, 1-pounder, 37 millimetres,	145	581	581	2,381
RALEIGH.				RALEIGH.				
6-inch rifles	56.00	560	6,310	6-pounder	215	1,290	1,435	7,745
5-inch rapid-fire guns.	115.00	5,750		1-pounder	145	145		
INDIANA.				INDIANA.				
13-inch rifles..........	6.8	7,480	10,680	6-pounder ...	423	2,538	2,603	11,283
8-inch rifles	8.00	2,000		1-pounder	65	65		
6-inch rifles..........	12.00	1,200						
COLUMBIA.				COLUMBIA.				
8-inch rifles	3.27	817	2,128	6-pounder	300	1,800	1,851	3,979
6-inch rifles	4.10	410		1-pounder	51	51		
4-inch rapid-fire guns.	27.00	891						
CINCINNATI.				CINCINNATI.				
6-inch rifles.....	6.00	600	5,150	6-pounder	290	1,740	1,770	6,920
5-inch rapid-fire guns.	91.00	4,550		1-pounder	30	30		

In this table, as in the previous one, there is no comparison of the personnel, but simply of the gun power of the different ships. In this comparison there are many surprises and many valuable hints. The armored cruiser New York threw within twenty per cent. as much metal as did the battle-ship Indiana, the former with 8-inch and 4-inch guns, and the latter with 13-inch, 8-inch and 6-inch guns. The Cincinnati and the Raleigh, each with five 5-inch rapid-fire guns and one 6-inch rifle, in broadside, fired three times as much metal as did the Newark, a ship half again as large, having six 6-inch rifles in broadside. This latter fact shows the great gain in adopting rapid-firing batteries, because the penetrating and destructive power of the new 5-inch rapid-fire guns is as great as that of the 6-inch guns of the Newark. The Cincinnati and the Raleigh, therefore, could each do three times as much damage as could the Newark, with the same number of guns.

The comparison of the Indiana and the New York presents the same argument in favor of the rapid-fire guns of medium caliber. The New York, with six 4-inch rapid-fire guns in broadside, threw more metal than did the Indiana's four 8-inch and two 6-inch rifles. And had the New York been supplied with 5-inch rapid-fire guns, which can be fired quite as rapidly as the 4-inch gun, as demonstrated by the Raleigh, she would have fired 11,690 pounds of metal—that is, 600 pounds more than the Indiana fired from all her guns, including those of 13-inch caliber.

Nothing more is needed to demonstrate the value of the 5-inch rapid-fire guns. The cartridge is not so heavy that it cannot be quickly handled, in which it is superior to the 6-inch, and is hardly less manageable than is the 4-inch. It is a happy mean.

In the case of the Columbia the record shows that this ship, with a displacement of nearly 8000 tons, is so deficient in gun power that she can throw only half as much metal as do the Cincinnati and the Raleigh, of 3200 tons.

This is the most striking instance of several in the new Navy, where gun power and battle efficiency have been sacrificed or forgotten.

The study of these valuable tables shows the necessity of returning to the policy that gave victory to Decatur, to Hull and to Farragut—the policy of providing our ships with plenty of ammunition and with batteries that can fire it rapidly and accurately.

The vessels of the North Atlantic Squadron, under Adml. Bunce, engaged in manœuvres, are at present off Fishers Island, New York. The squadron left New York Sept. 1, consisting of the New York, Texas, Indiana, Raleigh, Maine, Columbia, Massachusetts, and the Newark. The Newark was detached at the light-ship and ordered to proceed to Key West to relieve the Montgomery. When the squadron rounded the eastern end of Block Island, the battle-ship Massachusetts was detached and ordered to proceed to Newport to get her outfit of torpedoes, and rejoin later on. Adml. Bunce ordered landing drills to take place. The orders directed the following general plan to be followed: First day, organization and equipment on board ship to insure compliance with all the requirements of squadron regulations. Afternoon, disposition of the men in boats. Second day, forenoon, company exercises; afternoon, same in extended order on shore. Third day, forenoon, battalion exercises; afternoon, same in extended order. Fourth day, ball cartridge practice; forenoon by company, afternoon by battalion. Fifth day, brigade battle formations. Sixth day, forenoon, outpost duty, advance and rear guards; afternoon, pass in review.

On Sept. 9 the men of the fleet were landed for drill. The battalions were first embarked and manœuvred in line and columns of boats. The flotilla presented a fine appearance, and the fifty boats were handled with ease by signals. After the landing the different battalions marched to their drill grounds and spent the day, from 9 A. M. till 5 P. M., in practical manœuvres. Officers and men are reported working hard and enthusiastically.

New York Timber Dock.

[Army and Navy Journal.]

The new timber dry dock at New York Navy-yard is now practically finished, and after being inspected by the Government officials will, if found to be up to the specifications, be formally accepted. The dimensions of the dock, which is said to be the largest in the United States, are given as follows: Length on top from head to gate, 670 feet; width, 151 feet on the top and 60 feet 4 inches at the bottom; gate, 108 feet 8 inches on top and 71 feet 6 inches on the bottom. There will be 29 feet of water over the sills, while the gate will be 35 feet 6 inches high. A sea wall 200 feet on either side of the gateway is to be constructed of stone. It is expected the work will be completed and the dock ready for occupancy early in September. The pumping station has been completed for several weeks and, besides the three pumps, with a capacity of 200,000 gallons a minute, the dock can be flooded without their assistance, as it is connected with the basin by two large pipes and one small pipe, and by turning a valve the water will flow into the dock from outside.

SHIPS OF WAR.

[ENGLAND.]

THE ISIS.

On June 27th, at Govan-on-the-Clyde, the new second-class cruiser Isis was launched from the yard of the London and Glasgow Engineering Company. She is the last to take the water of the six cruisers of the Talbot type, which were entrusted for construction to private builders. Her dimensions are as follows: Length, 350 feet; beam, 54 feet; and with a draught of water of 20 feet 6 inches, she has a displacement of 5600 tons. The stem, stern-post, and shaft brackets are of phosphor bronze, as are also the twin propellers. Internally the hull is subdivided transversely and longitudinally by numerous bulkheads, and the vital portions of the vessel are protected by a continuous steel deck, varying in thickness from 3 inches to 1½ inches. In the vicinity of the engine-room additional safety is provided for the propelling machinery by an armored citadel, formed of 5-inch Harveyized steel plates. The armored conning tower, from which the vessel will be manœuvred in action, is built of the same material, 6 inches thick. Externally the hull is sheathed with teak 3 inches thick, and this will be covered with copper after the vessel has been handed over to the dockyard authorities. For about a third of her entire length amidships teak bilge keels are fitted, and these are cased with brass plates. The propelling machinery, which will be fitted on board by her builders, comprises two sets of triple-expansion engines, in separate compartments, having cylinders of 33 inches, 49 inches, and 74 inches diameter, with a common stroke of 39 inches. Steam is supplied from eight single-ended boilers of the Navy type, at a pressure of 155 lbs. to the square inch. Each boiler has three corrugated steel furnaces, and appliances are fitted as usual to enable the vessel to steam either with forced or natural draught. Under forced draught the estimated speed is 19.5 knots, the engines developing 9500 I. H. P. The armament will comprise five 6-inch guns, so arranged that three may fire in direct line ahead and two direct astern in line with the keel, six 4.7-inch guns, besides nine 12-pounders and a number of smaller guns, all being Q. F. In addition, the hull is pierced for three torpedo-discharge tubes, two submerged and one above water at the stem. The vessel is lighted throughout by electricity. The installation includes three powerful search-lights, and a new multiple flash-light for signaling purposes will be fixed at the masthead. Consequent on the improved methods in the manufacture of steel and the experience gained by its extended use for shipbuilding purposes, the Whitehall authorities have now demanded a higher tensile strength from the manufacturers. Until recently it was obligatory that plates should stand a tensile stress of from 26 to 30 tons per square inch of section. All future plates for Admiralty purposes are, however, to successfully stand a stress of from 30 to 35 tons.

THE ECLIPSE.

[JOURNAL OF THE ROYAL UNITED SERVICE INSTITUTION.]

The new second-class cruiser Eclipse, which was built and engined at Portsmouth, has carried out her official steam trials with satisfactory results. The ship is propelled by two sets of three-crank triple-expan-

sion engines, with cylinders of 33 inches, 49 inches, and 74 inches diameter, by 39 inches stroke. The main bearing frames, piston, cylinder, and slide covers are of cast steel, and the ordinary double eccentric gear is used for actuating the slide valves, the reversing motion being of the all-around design, which alone is now accepted for ships of the Royal Navy. The steam supply for the engines is obtained from eight boilers of the return multitubular type, each boiler being 14 feet 6 inches in diameter and 9 feet 11½ inches in length. There are 24 corrugated furnaces of 3 feet 9 inches diameter, each fitted with bars giving a total grate surface of 630 square feet. With the exception of the two main feed pumps, by Messrs. Weir, of Glasgow, the propelling machinery has been designed and made entirely in Portsmouth Dockyard, and the arrangements generally, having regard to their completeness, accessibility of parts, and simplicity, indicate the ability to steam at full speed as long as her coal capacity will carry the ship without any more risk than is incurred by the Atlantic liners. The normal draught of the ship is a mean of 22 feet 6 inches, but during the trials her draught was only 18 feet 8 inches forward and 22 feet 4 inches aft. The results during the eight hours' run under natural draught were as follows: Steam in boilers 152.7 lbs., and the vacuum 25.7 inches starboard and 26.5 inches port; the revolutions were 135.7, and the collective I. H. P. 8220, or 220 above the contract, while there was an air pressure of only 0.39 inch. After leaving Portsmouth the ship passed to the eastward of the Isle of Wight, and on reaching Portland turned, pursuing an eastward course till Brighton was neared, and then she turned again for Spithead, where she anchored for the night, having maintained a uniform speed of 19.2 knots. The engines worked with remarkable smoothness, the average temperature in the engine-room being 85. The coal consumption per I. H. P. per hour was 2.27 lbs. On the four hours' run, under forced draught, the following results were obtained: Steam in boilers, 155 lbs.; vacuum, 25.7 inches starboard and 26.6 inches port; while the average revolutions were 141.17 starboard and 142.36 port per minute. The starboard engines gave a mean H. P. of 4820, and the port engines of 5033, or a collective power of 9853, being 253 above the stipulated power. The speed as registered by patent log was 20.1 knots. The engine-room and stokehold were so cool during the trial that the two exhaust fans were not required. The trial was regarded as perfectly satisfactory. The vessel also went through her circle trials, answering her helm admirably. During the thirty hours' run which followed, her mean draught was 18 feet 2 inches forward and 22 feet 2 inches aft, and she had 135.6 lbs. of steam in her boilers, with a vacuum of 26.5 inches on both sides. With 115.7 revolutions starboard and 116.3 port, her engines showed 2418 and 2420 H. P. respectively, or a collective H. P. of 4838. There was no air pressure, and the consumption of 1.83 lbs. of coal per I. H. P. per hour she gave a mean speed of 16.8 knots. In view of the fact that the ship at all her trials was drawing much less than her normal sea draught, it cannot be said that the speed obtained was as high as it ought to have been.

THE TERRIBLE.

[ENGINEERING.]

The new first-class cruiser Terrible has arrived at Portsmouth and been placed in the new dock, No. 14, to be completed for sea. During

her trials on the Clyde the Terrible, with 100 revolutions, attained a speed of 20½ knots, and with 105 revolutions 21½ knots. At 4.30 on the morning of June 23rd she left Hellensburg for Portsmouth, using only 24 out of her 48 boilers, and two hours after starting, with 70 revolutions, she attained a speed of 15 knots, which she maintained till she arrived at Spithead late on the evening of the 24th. She had fine weather with smooth sea, but an adverse tide for the greater part of the distance, but no difficulty was experienced in keeping a uniform speed, and the Belleville boilers worked very satisfactorily. With all her stores on board the Terrible will have an even keel, drawing 27 feet both fore and aft, but having no stores on board, and having shipped only 500 tons of coal, though her capacity is 3000 tons, she drew only 20 feet 4 inches and 26 feet 4 inches aft when she started, thus giving her an appearance of standing too high out of the water forward. The machinery and boilers gave no trouble of any kind, and the speed would have been better but for the fact that she is at present only wood sheathed and has been in the water for thirteen months, having been launched in May, 1895. Her guns are not yet on board, and her barbettes cannot be completed until the guns are mounted, but the casemates are in position and ready for the auxiliary armament. On the trip to Portsmouth her steering geer answered admirably. The vessel is in a forward condition, and could be prepared for sea in two months, as she has only to be copper sheathed and have her submerged torpedo-tubes fitted.

New Battle-ships.

[Engineering.]

The Admiralty have given out orders for the construction of five battle-ships of a new class to be known as the Canopus type. One is to be constructed by the Thames Iron Works and engined by Messrs. Maudslay, Sons, and Field, both of London; a second is to be built and engined by Messrs. Laird, of Birkenhead; a third is to be constructed at the Chatham Dockyard and engined by Messrs. Penn, Greenwich; and the other two are to be laid down at Portsmouth and Devonport respectively. These vessels are to be of 2000 tons less displacement than the Majestic class, our largest battle-ships, one advantage, in addition to less first cost, being that they will be able, owing to less draught, to go through the Suez Canal. Their length is 390 feet and the beam 74 feet, the displacement being 12,950 tons and draught 26 feet. Structurally they will be similar to the Majestic class, but to secure the reduction in displacement certain modifications have had to be made, the most significant being a reduction in the thickness of the Harveyized armor which protects the broadside for the greater part of the length and for some 18 feet of its depth. The new ships will have 6-inch plating instead of the 9-inch in the Majestic, but the armament will be the same, four 12-inch 45-ton guns being mounted *en barbette*, and these guns by reason of their great length—35.43 calibers—give, with an 850-lb. shot, a muzzle energy of 33,940 foot-tons. There will also be twelve 6-inch quick-firing and 30 smaller guns. The engines are to be of the triple-expansion type, having cylinders 30 inches, 49 inches, and 80 inches in diameter by 51-inch stroke. The power is to be 13,500 indicated horse-power, which will give a speed of 18¼ knots, against 17½ knots in the Majestic. This increase in speed

is partly due to the adoption of Belleville water-tube boilers, a slight saving in weight per unit of power being utilized to add to the total power. These are the first British battle-ships into which the water-tube boilers have been fitted, but in this case an interesting change has been made in the design largely to secure a greater fuel economy. There will be placed in the uptake over each boiler practically a small boiler to serve as a feed-heater, the feed water passing into the bottom tube in this auxiliary and through the various tubes overflowing into the pipe leading to the main generator. There will be 20 boilers, with about 32,000 square feet of heating surface and 1100 square feet of grate area. The vessels, it is hoped, will be completed by the autumn of 1898.

THE VICTORIOUS.

[ENGINEERING.]

The natural draught trials of the Victorious, first-class battle-ship, which took place on Monday, August 31, proved satisfactory. They extended over eight hours, and the average speed was nearly 17 knots, the contract speed of 16¼ knots thus being exceeded. The contract indicated horse-power of 10,000 was also exceeded, and the machinery worked smoothly throughout. The vessel behaved splendidly. The contractors are Messrs. Hawthorn, Leslie & Co., and the engines are of the inverted vertical triple-expansion type (two sets).

The four hours' forced draught trials took place Sept. 2, and were very successful. Results were as follows: Steam in boilers, 147 lbs.; revolutions, 105.35; vacuum, 26.55; I. H. P., 12,210; speed, by log, 18.7 knots; the guaranteed speed was 17½ knots.

THE CÆSAR.

[ENGINEERING.]

The first-class battle-ship Cæsar, which is one of the nine vessels ordered under the Spencer programme, and the third of the series to be launched or floated at Portsmouth, was floated out of No. 12 dock on Sept. 2. The Cæsar may be regarded as an improved Majestic. The chief difference between the two most modern battle-ships is that the Majestic has a fixed loading position, with an auxiliary all-round loading, while the Cæsar has no fixed loading position, but has the same auxiliary as the Majestic; thus while the empty gun of the Majestic must come to the fore-and-aft position to load, thereby presenting itself as a target to the enemy should the ship be broadside on, to say nothing of the loss of time if the gun has just been fired on the beam, the Cæsar can reload as she fires in any position, owing to the improvement that has been effected in the design of the mounting and supply. The 12-inch wire guns of the Majestic and Cæsar have, in fact, the same penetrating power as the 110-ton guns of the Sans Pareil and Benbow. The gun mountings are designed and supplied by Sir John Whitworth & Co., and the machinery has been manufactured by Messrs. Maudslay, Sons, and Field. The principal dimensions of the Cæsar are: Length between perpendiculars, 390 feet; extreme breadth, 75 feet; mean draught of water, 27 feet 6 inches; displacement when fully equipped, about 15,000 tons. She will be fitted with twin screws, each driven by an independent set of vertical triple-expansion engines, capable of working up to 6000 indicated horse-power,

or a total of 12,000 for the two sets of engines, with a working pressure in the boilers of 150 lbs. to the square inch and an air pressure in the stokeholds equal to 1 inch of water. With this horse-power a speed of 18 knots will be realized. The normal amount of coal to be carried is 900 tons, but provision is made for stowing 2250 tons. The armor, which varies in thickness from 6 inches to 14 inches, consists of steel plates, the outer surface of which has been carburized by the Harvey process, and protection is afforded by this armor to the machinery, guns, and magazines. The Cæsar will carry two masts, each having two fighting tops, and each of these will carry three 3-pounder quick-firing guns with the necessary magazines and equipment. A steel derrick, about 61 feet in length, will be fitted on the mainmast for lifting the heavy boats into position on the skid beams, while on the foremast a wood derrick will be fitted for lifting the lighter boats and for coaling purposes. At the top of each lower mast, a distance of nearly 100 feet above the water, a platform will be built carrying a powerful search-light projector, while at the main topmast head, a distance of 170 feet from the water, a semaphore for long-distance signaling will be fitted. Including four steam boats, the Cæsar will carry no fewer than 18 small craft, three of the steam boats being capable of acting independently of the ship for the purposes of torpedo attack, and fitted for discharging 14-inch Whitehead torpedoes. One of the boats will also be fitted for carrying the spar torpedo. Four of the light boats will be carried in davits, to enable them to be rapidly lowered when required to act as lifeboats. The armament of the Cæsar is similar to that of the other ships which have been fully described in *Engineering*. Six search-light projectors, worked by three dynamos, each of 600 amperes, will be carried, and to complete the protection against torpedo attack the vessel will be fitted with the latest system of net defense.

TORPEDO-BOAT DESTROYERS.

THE STAR.

H. M. torpedo-boat destroyer Star was launched recently from the Howdon yard of the Palmer Shipbuilding and Iron Company, Limited. The vessel is the first of eight of the same class which are being built by the Yarrow firm for Her Majesty's Navy. Her dimensions are: Length, 215 feet; breadth, 20 feet 9 inches; and the displacement is about 300 tons. Her armament consists of one 12-pounder quick-firing gun forward on the conning tower, with four 6-pounder quick-firing guns on the broadside, and one 6-pounder on a platform aft. There are also two revolving torpedo-tubes on deck, arranged to fire on either broadside. The builders have guaranteed a speed of 30 knots, and the machinery, which has been designed by them, consists of two sets of triple-expansion engines, steam being supplied by four of Reed's patent water-tube boilers.

THE SWORDFISH.

The torpedo-destroyer Swordfish made her official trial on July 9 off the mouth of the Thames. The vessel is 200 feet long by 19 feet beam. She developed 4359 I. H. P., with average steam pressure of 194 lbs., and 394 revolutions per minute, attaining an average speed of 26.8 knots.

THE ELECTRA.

Messrs. James and George Thomson, Limited, launched on July 14th from their yard at Clydebank the torpedo-boat destroyer Electra, which they have designed and built to the order of the British Government. This is a sister ship to the Brazen, launched by the same company some days ago, and is the second of four vessels ordered at the end of last year. These vessels are to attain a speed of 30 knots.

THE HARDY.

The new torpedo-boat destroyer Hardy, built by Messrs. Doxford & Sons, of Sunderland, has also completed her official full-power trials on the measured mile off the Maplin Sands. The speed stipulated for by the Admiralty is 26 knots, and the Hardy easily achieved a mean rate of 26.8 knots for six runs over the measured mile, and a mean speed of 26.514 knots for three hours' continuous steaming. The mean steam pressure in the boilers was 189 lbs. per square inch, and the mean revolutions were 380 per minute. The average I. H. P. developed was 4184.

THE POWERFUL.

The first-class cruiser Powerful, built and engined by the Naval Construction and Armaments Company, arrived at Portsmouth on July 17th and was taken into the repairing basin in readiness to be docked. Starting from the Devonshire dock at Barry at four o'clock on Monday morning, the 13th inst., in the presence of some thousands of spectators, the great cruiser was berthed in the Ramsden Dock till the tide served, and at noon she left for a run in the Irish Sea. She was berthed for the night at Liverpool, where, on Tuesday, the ship brought up her coal supply to 1200 tons and took on board fresh water. On Wednesday she had an unofficial trial of her machinery, slowly working, up to 95 revolutions, at which, in a run of six hours, she maintained a mean speed of 19 knots, with all her 48 boilers in use. Having landed some of the officials, the ship left Liverpool at 8.30 on Wednesday evening, using at first only 16 boilers, and, with 60 revolutions, she gained a speed of 12 or 13 knots; but on Thursday morning eight more boilers were lighted up and the revolutions increased to 75, when the speed slightly exceeded 15 knots.

REMOVAL OF TORPEDO TUBES.

The Admiralty have ordered the stern torpedo-tubes to be taken out of all ships of the Royal Sovereign class, and these vessels will now carry only the submerged tubes. There are two very substantial reasons for this course. Experiments have been made which have demonstrated the possibility of hitting the whiskers of a torpedo by means of quick-firing guns while the weapon is in the tube, and thus hoisting the engineer with his own petard. Then, says the *Naval and Military Record*, it has been found on the China station that where the stern tube is reasonably near the water-line, the seas in rough weather fill the tube, and if the torpedo is there, collapse the balance chamber. The trials of the Eclipse were especially directed to elucidate this point, but though no accident occurred in that cruiser, owing to her tube being well out of the water,

an immunity from accident is not guaranteed to ships less favorably constructed. Hence the necessity that has arisen for removing the tubes.

TEST OF HARVEYIZED PLATE.

An experimental Harveyized armor plate, produced by Messrs. John Brown & Co., Atlas Steel and Iron Works, Sheffield, was tested on board H. M. S. Nettle with most satisfactory results. The plate was 8 feet by 6 feet by 6 inches, and five Holtzer projectiles, weighing about 100 lbs. each, were fired at it, with the full charge of E. X. E. powder, giving a velocity of 1960 foot-seconds. All the shots were broken up, fragments of two only entering into the wood backing very slightly. In spite of the extraordinary resistance thus given, the plate proved so tough that only one slight hair-track was perceptible after the firing of the fifth shot. The trial was witnessed by Sir William White, K. C. B., Captain Jeffreys (H. M. S. Excellent), Captain May (of the Ordnance Department), and other officials.

[FRANCE.]

D'ENTRECASTEAUX.

[ENGINEERING.]

The D'Entrecasteaux, first-class cruiser, launched at La Seyne on June 11 from the yard of the Société de la Méditerranée, is, with the exception of the Guichen, "commerce destroyer," the largest unarmored vessel in the French Navy. The following are her principal dimensions: Displacement, 8114 metric tons; length, 393 feet 8 inches; beam, 58 feet 6 inches; draught, 25 feet 9 inches. Her armament will consist of two 9.4-inch guns in closed turrets (2.7-inch plating), severally fore and aft, and twelve 5.5-inch and twelve 1.8-inch quick-firers, besides six torpedo-tubes, of which two are submerged. Cylindrical double-ended boilers and two vertical triple-expansion engines developing 13,500 horse-power are to give a speed of 19 knots, and, with the normal coal supply of 650 tons, the range will be 5500 miles at 10 knots and 900 miles at full speed. The cruiser will have a complement of 21 officers and 500 men. She is built of steel and sheathed for foreign service, and her cost is stated to be £667,740. The designs are by M. Lagane, who prepared the plans for the Jauréguiberry. The vessel was laid down in 1894, and is to be delivered, by the contract, at the close of 1897.

THE CHARLES MARTEL.

[JOURNAL OF THE ROYAL UNITED SERVICE INSTITUTION.]

The new first-class battle-ship Charles Martel had a satisfactory preliminary trial under 11,000 I. H. P., with the following results: I. H. P. realized, 10,990; revolutions of engines, 89; consumption of coal per H. P. per hour, 1.03 kilogramme; consumption per square meter of grate surface, 120 kilogrammes; speed, 16.8 knots. The new second-class cruiser Descartes has been continuing her official trials; during a run of 24 hours, at full speed under natural draught, a mean speed of 17.5 knots was maintained; the engines developed 5802 I. H. P., making 118.5 revolutions; coal consumption per H. P. per hour, 0.753 kilogramme; and consumption

per square meter of grate surface, 70 kilogrammes; during the full-speed trial, under forced draught, the engines developed 8870 I. H. P., making 135 revolutions; coal consumption per H. P. per hour, 0.965 kilogramme; consumption per square meter of grate surface, 135 kilogrammes; and the mean speed, 19.5 knots.

The Explosion on Board the Amiral Duperré.

On May 14 an explosion occurred on board the Amiral Duperré, flagship of the French Mediterranean Reserve Squadron. It was discovered that a cartridge for the 13.3-inch gun had exploded in the passage leading to one of the magazines, which at the time contained nearly five tons of powder, so it is evident that the escape from a terrible disaster must have been very narrow. It is stated that the explosion was caused by the spontaneous decomposition of the powder in the cartridge due to the excessive temperature in the passage, which was more than 104 Fahr., a heat sufficient to cause the powder to decompose and give off inflammable gases. In consequence of this accident, a careful examination of the magazines of the Hoche, the new flagship of the squadron of the North, has been made, and the temperature of those for the 27-cm. and 14-cm. guns, which are in the center of the ship, being found very high, at the request of the admiral the ammunition has been removed and temporarily placed in the magazines on shore.

Experiments with Melinite Shells.

The experiments with melinite shells, which have been carried on against the obsolete ironclad La Galissonniere, have concluded, and the ship has been towed back to Toulon. The results of the experiments have not been divulged, but it is stated that six shells, charged with 39.6 lbs. of melinite, were fired from a 7.4-inch gun, that they penetrated 2.9 inches of Harveyized steel and burst on board, doing an enormous amount of damage. Up to the present, nobody but a few officials and the members of the committee have been allowed to examine the damage done to the ship.

[Italy.]

Italian War-ship Building Notes.

Three new first-class battle-ships of the Re Umberto type, but with somewhat less weight of armor and a larger secondary battery of Q. F. guns, are shortly to be commenced—one at Spezia, one at Castellamare, and the third at the Ansaldo yard at Sampierdarena, Leghorn. The ships under natural draught are to have a speed of 20 knots, and 22 knots under forced draught. The engines and boilers are to be manufactured by the firms of Ansaldo, Odero, and Guppy, respectively.

The Minister of Marine has ordered from the Odero firm at Sestri Ponente a new torpilleur-de-haute-mer of a special type. She is to be 152 feet in length, 18 feet beam, and with a draught of 3 feet 4 inches will have a displacement of 135 tons; the engines are to develop 2500 I. H. P. and to give a speed of 25 knots.

The Marco Polo.

The new armored cruiser Marco Polo has lately completed her final acceptance trials at Naples, and will shortly reinforce one of the active service squadrons.

She was built in the Royal Dockyard at Castellamare di Stabia, and engined by G. Ansaldo & Co., of Sampierdarena. Her dimensions are as follows: Length between perpendiculars, 327 feet; beam, 48 feet; and with a draught of just over 19 feet, she has a displacement of 4600 tons. The engines were required to develop 6000 I. H. P. with natural draught, and 10,000 I. H. P. with forced draught. There are two independent sets of engines and shafting in separate compartments, and two separate boiler-rooms, one before and one abaft the engine-rooms, each containing two cylindrical double-fronted boilers. The weight of the propelling machinery complete with all accessories, water in the boilers and condensers, etc., is about 800 tons. Forced draught is obtained by ventilators on the closed stokehold system. Each engine has four cylinders, one high pressure, one low pressure, and two other, also low pressure, of 37 inches, 57 inches, and 62 inches diameter respectively, and a stroke of 30 inches. The high pressure cylinders only are fitted with cylindrical slide valves; the supporting columns rest upon girders forming part of the structure of the ship. The propellers are four-bladed, of manganese bronze, 14 feet diameter, with a mean pitch of about 15 feet. The condensers have a cooling surface of 1100 square meters each, the auxiliary condensers 70 square meters. A small independent engine is provided for working the circulating and air pumps; the latter, two in number, are single acting; the circulating pumps are capable of drawing from the bilge and discharging overboard 700 tons of water per hour.

The ship is protected by an armor belt of 4-inch steel, from the upper deck to about 3 feet 3 inches below the water-line for about two-thirds of her length, connected at the ends by armored athwartship bulkheads of the same thickness of steel. There is also a 2.5-inch armor deck extending the whole length of the ship. She is provided with a double bottom, cellular construction between the protective and lower decks, and longitudinal cofferdams fitted with cellulose.

The armament consists of six 152-mm. (6-inch) Q. F. guns, ten 4.7-inch Q. F. guns, together with a large number of Q. F. guns of smaller caliber. There are also five torpedo discharges, one bow submerged and four above water broadside. The official trials for coal consumption of 10 hours' duration, as required by the contract, were carried out at Naples in December, 1895. With all boilers alight and with steam pressure varying between 135 and 150 lbs., the revolutions were 125 to 126, and the I. H. P. 7150, with a coal consumption of 1.87 lbs. per I. H. P. per hour. The mean speed for the whole duration of the trial was about 17 knots.

In the subsequent forced-draught trial of three hours, in the month of January last; the power developed was about 10,700 I. H. P., with 140 revolutions, and a coal consumption per I. H. P. of 2.1 lbs. The air pressure by the water barometer for the forced draught was from 2 to 2½ inches. The speed on this trial was 19 knots, but it would certainly have been much higher if the ship had been docked and her bottom cleaned, as she had been lying in the basin for some months.

[GERMANY.]

KAISER FRIEDRICH III.

[JOURNAL OF THE ROYAL UNITED SERVICE INSTITUTION.]

On the 1st of July, at Wilhelmshaven, the new first-class battle-ship Ersatz Preussen, but now the Kaiser Friedrich III, was successfully launched in the presence of the Kaiser.

The dimensions of the ship are as follows: Length between perpendiculars, 373 feet 9 inches; beam, 67 feet; and the mean draught of 25 feet 8 inches, she has a displacement of 11,130 tons. Protection is afforded by a water-line belt of hardened steel, extending from the ram aft for four-fifths of the vessel's length, with a maximum thickness of 12 inches tapering to 6 inches; there is an armored deck on top of the belt 2.5 inches, and a second armored under-water deck, extending from termination of belt to stern, 3 inches thick. The armament is composed of 24-cm. (9.4-inch) guns disposed in two turrets, one forward and one aft, protected by armor of 10-inch hardened steel; a secondary battery of eighteen 15-cm. (5.9-inch) Q. F. guns, six of which are carried in 6-inch armored turrets, and the remaining twelve in 6-inch armored single casemates; twelve 8.8-cm. (3.3-inch) Q. F. guns on the superstructure deck, protected by shields; and twenty small Q. F. guns distributed between the tops and various parts of the ship. There are six torpedo-tubes for 18-inch torpedoes, one in the stem, one in the stern, and two on each broadside. The ship will have three screws, and the engines are to develop 13,000 I. H. P., giving a speed at load draught of 18 knots. The boilers will be partly cylindrical and part water-tube, while the coal capacity at load draught will be 650 tons. There will be two military masts, and the crew will number 655 officers and men.

[RUSSIA.]

The activity of Russia in developing Vladivostock since the war between Japan and China has led to a great demand for Chinese labor at that port. It is estimated that during the present season fully 10,000 Chinese coolies have been shipped from Shanghai and other ports to work on the fortifications, the great dry docks, and the railway which is being built eastward to meet the trans-Siberian overland road. The fortifications are said to be more powerful than those which the Chinese built at Port Arthur, although for seven months in the year ice effectually bars entrance to the harbor. The Russian military officials are said to have received stringent orders against any inspection of the harbor or city fortifications, and they even go to the length of forbidding tourists or any residents from ascending the hills, from which a good general idea may be secured of the works and of the depots for ammunition. For years it has been the custom of military and diplomatic officials and business men to hunt and fish with perfect freedom near the city; but now shooting and fishing permits are difficult to obtain, while arrest and fine await any sportsman who fails to get the necessary permission from the commandant.

Orders have been given, says the *St. Petersburgskiya Viedomosti*, to the Admiralty works at Ishora to build two "destroyers" of the Sokol type. The Normand torpedo-boat Pernoff, which was intended for service with the Mediterranean squadron, will, according to the *Army and Navy Gazette*, be detained to serve as a model at the same works. The torpedo-boat Pakerort will go in its stead.

[SPAIN.]

WAR-SHIP BUILDING NOTES.

The Spanish Minister of Marine has applied to the Spanish Council of Ministers for special credits to the amount of £920,000 for increasing the Spanish fleet and extending the Spanish arsenals and naval establishments. The special credits include an item of £80,000 for the new first-class cruiser Reina Regente. The Spanish Minister of Marine further contemplates the construction of an ironclad to have a displacement of 11,000 tons, and to cost £880,000; two cruisers of 6800 tons each, and two torpedo-boat destroyers. The Minister further proposes to equip the Pelayo with rapid-firing guns, and to convert the Numancia frigate into a floating battery.

The Spanish Government has closed the contract for the purchase of two cruisers now building in the Ansaldo works, Leghorn, to be named the Cristobol Colon and Pedro d'Aragona, and to cost from 17 to 18 million francs.

It has also been decided to purchase in Scotland an ironclad of 10,500 tons, a cruiser of 6500 tons, and two torpedo-catchers. A cruiser of 1500 tons, having a speed of 20 knots, is also to be built in England. According to the contract the vessels are to be built in 18 months.

In view of the present activity displayed by the Naval Department, the following particulars of the various vessels built and being built on the home station may prove interesting.

The Pelayo, ironclad, at present at Cadiz, carries four big guns and about twelve of smaller caliber, with the usual number of Nordenfelt, Hotchkiss and other quick-firing pieces. She is employed as the flag-ship of Rear Admiral Requera, and is capable of doing fifteen knots on a push.

The Vizcaya, also in Cadiz, is a belted cruiser, 7000 tons, and carries two 28-cm. guns in protected turrets and ten of 14-cm., with also a number of quick-firing Nordenfelts. Her speed is eighteen knots natural draught and twenty forced draught.

The Maria Teresa and Oquendo, two sister ships to the Vizcaya, are in commission at Barcelona.

There are three torpedo-boats at Carracas (near Cadiz) and other three at Cartagena. Also at Cartagena, Carracas and Ferrol are a few obsolete vessels. Two or three of these might, on an emergency, be put in commission, but this is scarcely likely, owing to their having old-fashioned boilers and machinery.

Before the 18th of September the Princessa de Asturias, it is expected, will be launched. Her hull is of steel; tonnage, 7000; draught, 6.58. She has an armor belt of 300 mm., tower, 300, and protective deck, 50; will carry two guns of 240 mm. Hontorio; eight of 57 Nordenfelt; eight of 37 Hotchkiss; two mitrailleuses of 11 Nordenfelt, and two of 70 Hontorio, besides eight torpedo-tubes. Indicated horse-power, 15,000; speed, 20.25; coal capacity, 1200 tons, sufficient for 9700 miles at ten miles per hour. Crew complement, 497 men.

In the arsenal at Ferrol, nearly ready for launching, is the Cardenal Cisneros, belted cruiser, 9000 tons.

The Catalina is on the stocks at Cartagena. These two vessels are sister ships to the Princessa de Asturias, described above.

In construction also at Ferrol, but in a private yard, are three gunboats of 600 tons each.

Great activity is being at present observed in the construction of the Carlos V, 900 men being employed. The government is desirous of having her ready for sea in as short a time as possible.

The Lepanto, a sister ship to the unfortunate Reina Regente and Alfonso XIII, with a few modifications, is nearing completion at Cartagena, and will probably be ready for her sea trials about March. The Alfonso XIII has undergone some preliminary trials, but is still at Ferrol. The boilers of the torpedo-boat destroyer Distructor, which was built some years ago by Messrs. Thompson, of Glasgow, are in a bad state of repair.

[BRAZIL.]

THE BARROZO.

Sir W. G. Armstrong & Co. (Limited) launched from the Elswick shipyard, Newcastle-on-Tyne, on Tuesday, August 25, the Barrozo, a cruiser built to the order of the Brazilian Government. The Barrozo is built of steel, her under-water portions being sheathed with wood and coppered. Her principal dimensions are: Length, 330 feet; breadth, 43 feet 9 inches; draught, 16 feet 10 inches; and displacement, 3450 tons. She is protected throughout the whole of her length by a curved steel armor deck. This deck completely covers all the machinery, magazines, and steering gear, and additional protection is afforded by the reserve coal bunkers, which are carried along the vessel's side to a height of about 6 feet above the water-line. With full bunkers the vessel will be able to traverse a distance of about 8000 knots at a moderate speed. The vessel is fitted with twin screws and machinery of 7500 indicated horse-power. She is expected to attain a speed of 20 knots. The Barrozo will be provided with guns of Elswick pattern, the armament comprising six 6-inch quick-firers of 50 calibers in length, four 4.7-inch quick-firers of 50 calibers, ten 6-pounder and four 1-pounder Nordenfelts, four Maxim guns, and two field guns. She will also have three torpedo-tubes. The six 6-inch guns are arranged to fire three ahead and three astern.

SHIPS BUILDING.

There are under construction for the Government at present the following ships: In France, two small battle-ships; in England, three protected cruisers; in Germany, three torpedo-cruisers; and in the dockyard at Rio, two monitors for river service. It is further contemplated to add three more cruisers, the orders for which are expected to be placed in Italy.

The three torpedo-cruisers are being built in the Germania yard at Kiel, and the first of them, the Garamuru, was launched in April last. Their dimensions are as follows: Length, 260 feet; beam, 31 feet; and with a mean draught of 10 feet 3 inches the displacement will be 1030 tons. The engines are to develop 6000 I. H. P., giving a speed of 23 knots. The armament will consist of two 105-mm. (4-inch) guns, six 57-mm. (2½-inch), and four 37-mm. (1.5-inch) guns, all Q. F., with three torpedo-discharges, one in the stem and one on each beam. A small twin-screw gunboat is also being constructed by Messrs. Yarrow.

[CHILI.]

THE ALMIRANTE SIMPSON.

The torpedo-gunboat Almirante Simpson, built and engined by Messrs. Laird Brothers, Birkenhead, for the Chilian Government, was taken by them to the Clyde for her official trials on July 23rd. The runs were made in accordance with the Admiralty conditions on the measured mile at Skelmorlie, with an average of 21½ knots on six runs on the measured mile, and a mean speed for three hours' running of 21¼ knots, the contract speed being 21 knots. On the natural-draught trial of six hours' duration a mean speed of 17¾ knots was obtained with ½-inch air pressure, being ¾ knot in excess of contract, the coal consumption in both cases being very light. The vessel is similar to the Almirante Lynch and Almirante Condell, built by the same firm for the Chilian Government in 1890, and Her Majesty's ships Onyx and Renard, built in 1893. Her length is 240 feet, beam 27 feet 6 inches, and she is built of steel. The thickness of the side plating abreast the machinery is increased to afford additional protection. She has a topgallant forecastle and half-poop which give accommodation for officers and crew. The builders have also supplied and fitted the armament, which consists of one bow and two broadside 18-inch torpedo-tubes, two 4.7-inch quick-firing guns of Armstrong's most modern type, four 3-pounder quick-firing guns, and two rifle caliber machine guns by Maxim-Nordenfelt. The machinery consists of two sets of triple-expansion engines supplied with steam at 200 lbs. pressure from four water-tube boilers of the modified Normand type, first introduced by the builders, with extra large evaporators and distillers. This vessel has been rapidly constructed, the order having only been placed in September of last year.

The Chilian Government has ordered from the firm of Ansaldo and Co., of Sestri Ponente, Leghorn, an armored cruiser similar in type to the Garibaldi, which, built originally for the Italian Government, has lately been sold to the Argentine Government. There is considerable jubilation felt in Italy at the increasing number of war vessels which are being constructed for foreign governments in Italian yards. The Guardia Marina Riquelme, fourth and last of the 30-knot torpedo-boat destroyers, building by Messrs. Laird for the Government, was launched at Birkenhead, June 20th.

[ARGENTINE.]

THE SANTA FÉ.

[ENGINEER.]

The Santa Fé is the first of four destroyers ordered by the Argentine Government. The names of the remaining three are Corrientes, Misiones, and Entre Rios. They are 190 feet in length by 19 feet 6 inches beam, and one special feature in which they differ from similar vessels in the British Navy is that the machinery space is partially protected by ½-inch armor. This partial protection with tough steel plates extends on each side and on the deck throughout that portion of the vessel occupied by the machinery and by the men who work it. In spite of this extra weight of armor, the speed of the Santa Fé, which was recently tried on

a three hours' run, was found to be 26.7 knots, carrying a load of 35 tons with only 1¼ inches air pressure in the stokehold. The armament of the Santa Fé consists of two deck torpedo-tubes, and one bow tube of the Whitehead pattern, also one 14-lb. Maxim-Nordenfelt gun, placed in an elevated position on the conning tower forward; two 6-pounders are placed amidships, and one 6-pounder at the stern; while two Maxims are placed on either side of the conning tower on deck. The engine-room contains twin-screw engines of 4000 horse-power, besides many other auxiliary engines.

The steam is supplied by six of Yarrow's patent straight-tube water-tube boilers, four being placed in the main and two in the forward stokehold. These stokeholds are kept cool and supplied with air by forced draught produced by two brass fans, revolving in a horizontal plane, close below the deck. The boilers are each encased between diaphragm plates, so that in case any boiler is damaged by shot the influx of steam would be confined to that portion of the vessel occupied by the boiler so injured, and would not pass into the stokehold. This has been proved, by actual experience, to be an important method of protection to the stokers in case of a boiler being struck by the enemy's shot. It may, in passing, be mentioned that in the Santa Fé there are no less than between five and six miles of tubing in the boilers, every inch of which can be readily examined and cleaned. The deck accommodation of the Santa Fé is commodious, and the fitting up for the six officers and forty-four men shows that, as far as possible, the comfort of "those who go down to the sea in ships" has not altogether been forgotten.

We now come to the automatic boiler feed. It has come to be understood that if water-tube boilers are to be worked in comfort there must be some form of automatic feed. The demand for steam is so constantly changing, and the quantity of water at any time in the boiler is so small, that incessant vigilance is necessary, on the one hand, to prevent the boiler from being filled up, with the prospect of drowning the main engines and breaking them down, or, on the other hand, of stinting the feed, with the risk of burning the tubes. The system adopted by Mr. Yarrow is the invention of Mr. Mariner, and is very novel and peculiar. It consists, in one word, in feeding each boiler separately by a Worthington donkey pump and placing the mouth of the steam pipe for supplying the donkey close to the water level of the boiler. If the water rises too high, it will enter the donkey steam pipe and choke the cylinder with water. Then the donkey will almost stop. If the water level falls, then the donkey will work fast and pump the level up again. The accompanying sketch will make the arrangement clear. The steam pipe is placed between two perforated deflecting plates as shown, in order to give it "solid" water to deal with. The level of the pipe is adjustable from outside by means of a cock joint. It might be imagined that this would cause much pounding and thrashing, but personal inspection on Saturday proved that the Worthington pumps work quite quietly. If the boiler is too full of water the pump still works slowly and extracts from the boiler the surplus water to the extent of the difference of the capacity of the steam and pump cylinders respectively, until the level in the boiler is corrected. Thus it will be seen that with this system not only is the water, if low, immediately raised to its proper level, but if too high, it automatically falls. The simplicity of this arrangement, as compared with other systems of automatically regulating the feed, is evident,

[illegible] full-speed official [illegible] arrangements were never [illegible] of the exhaust steam [illegible] pumping engines and [illegible] to the condenser [illegible] temperature [illegible] heat is [illegible] pumping engines we are not prepared [illegible] ready to meet every [illegible] demand. The [illegible] has been [illegible] for some time [illegible] Marine.

[illegible] has now been placed beyond [illegible] we may say that it is the [illegible] known that much credit is due [illegible] the boiler department at [illegible] the assistant [illegible] takes an active [illegible] of the engineering department at Poplar, a [illegible] to bring into play all [illegible] make a first-rate engineer.

[JAPAN.]

[ARMY AND NAVY JOURNAL.]

[illegible] were opened by an Imperial Board at the Japanese Legation in Washington for the construction of two high-class cruisers for the Japanese Navy. The bids were submitted by the Cramps and the Union Iron Works. America is thus launched into the shipbuilding [illegible] of the world. The Japanese Legation, in accordance with [illegible] from Tokio, issued invitations to the firms mentioned [illegible] to submit plans, specifications and proposals for two [illegible] cruisers of the following general dimensions: Displacement, [illegible] length [illegible] feet; beam, 48 feet; beam draft, 17 feet 6 inches; [illegible] speed under forced draught, 22½ knots; speed [illegible] draught, 20½ knots. The general type of the vessels specified [illegible] one of the latest additions to the Japanese [illegible]. The [illegible] submitted by the firms are complete and embody all [illegible] improvements in naval construction. The bids were opened in [illegible] the Japanese Minister, Comdr. Miyaoka, the naval attaché [illegible] Naval Constrs. S. Sakurai and S. Takakura, and Messrs. [illegible] Edward Cramp. The amounts of the bids are kept secret. [illegible] for them and the plans and will forward them with [illegible] Tokio for the action of the Government. The Japanese [illegible] also opened bids for the construction of one cruiser [illegible] above. These bids will also be sent to Tokio with [illegible]. The impression prevails that the Japanese Government [illegible] American bids in case they are not too much greater [illegible] French shipbuilders. It is believed in naval circles [illegible] will be built at Cramp's and the other at the Union Iron Works.

[CHINA.]

Li Hung Chang ordered three cruisers from the Vulcan Works [illegible]. They are to have the following dimensions: Length at water-[illegible] beam, 41 feet; draught, 16 feet. The draught is made small

on account of the shoal waters about the Chinese coast in the neighborhood of Tientsin. Displacement to be 2950 tons. The two engines of 7500 indicated horse-power to give a speed of 19½ knots. The vessels, protected by protective decks, will be armed with batteries of three 5.9-inch, eight 4-inch, six 1.5-inch guns, six Maxims and one 2.4-inch boat gun. There will be one submerged bow torpedo-tube and two above-water broadside tubes. The first of the cruisers to be ready in 15 months, the others in 18 months' time.

BOOK NOTICES.

Hand-book of the Howell Automobile Torpedo. Published by the American Ordnance Company. The hand-book, of 42 pages, gives a detailed description of the Howell torpedo, launching gear, motor, and accessories. Twenty descriptive plates from original drawings of the various parts of the torpedo accompany the text, in which they are referred to under the various headings.

Under "Routine for Practice Shooting," full instructions are given for making the different adjustments preliminary to firing, the preparation of the launching tube, the entering, spinning up and firing of the torpedo, how to pick it up and prepare it for a second shot.

Details of additional preparation in war service, routine for monthly inspection, tables of dimensions and weights are also given.

Three plates of target diagrams are very interesting. Plate 21 shows all the shots made at the Tiverton Testing Station during the season of 1894. The second shows 403 hits, out of 428 shots fired, in a rectangular target 90 feet long by 20 feet deep, the upper edge at water-line. There were only 11 actual misses, and 14 failures were due to accidental causes, such as breaking gear or diving to bottom.

Plate 22 shows sixty proof shots at 400 yards with the 14.2-inch torpedo. The set depth was 7 feet, and all shots were aimed at center with no allowance for tidal currents, yet all 60 shots struck at 5 to 10 feet below the surface in a rectangle 63 feet long.

Plate 23 shows the diagram of a target of eleven consecutive shots with the 18-inch torpedo, at 600 yards, made in December, 1895. This shows remarkable accuracy in the torpedo, which was set to run at 6 feet depth, with a speed of 32 knots at 400 yards and 28 knots at 600 yards.

H. G. D.

Le Passager: Guide Horaire de tous les paquebots français et étrangers. Published by Berger-Lévrault et Cie, Paris. A guide-book of five hundred pages, which contains time-tables, itineraries, routes, passenger rates, and generally useful information of every principal passenger steamship line in the world.

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JULY 2, 1896. Experiments with Melinite. A Test of Turrets. Steam Engines for Electric Generators (illustrated).

JULY 9. Proposals for Gun Forgings.

JULY 16. The Goubet Submarine Boat. The Relative Strength of Navies.

JULY 30. Towing Machine Improvements. The Riehle 200,000-pound Testing Machine (illustrated). A Free Silver Illustration.

AUGUST 6. Ordnance Supply Bids. Shipbuilding Programmes, 1896-1897.

AUGUST 13. Corrosion from Dissolved Copper (illustrated). A New Device for Coaling Steamers.

AUGUST 20. The Gun Power of our Battle-ships. Grover's Indicator Gear (illustrated).

AUGUST 27. Transatlantic Steamship Race. Fibrous Wrought-iron and Crystalline Steel—II. (illustrated). The Bazin "Roller" Steamer. Electrically Driven Carriage. Types of United States War Ships.

SEPTEMBER 3. A Novel Erecting Derrick (illustrated). Fibrous Wrought-iron and Crystalline Steel—III. (illustrated). Why an Electric Motor Revolves (illustrated). Speed Trials of the U. S. Cruiser Brooklyn.

SEPTEMBER 10. New Ocean Steamships.

SEPTEMBER 17. Bids for Battle-ships.

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JUNE 27, 1896. The New Battle-ship Kearsarge. The Indiana.

JULY 4. Oil Engine Signaling Plant for Light-ship No. 42. Test of Armor Plate for Russia.

JULY 18. Engines of the St. Louis and the St. Paul.

JULY 24. The Transatlantic Steamship.

Gives a history of the development of the Atlantic steamship.

Naval and Coast Defense. American Shipbuilding.

AUGUST 1. Hydraulic Lift Dry-dock at Union Iron Works. The New Battle-ships.

AUGUST 8. Determination of Gravity.

AUGUST 15 and 22. The Battle-ship Indiana (full illustrated description). Accident to New York Dry-dock.

SEPTEMBER 5. Trial of the Brooklyn. The Savage Rifle. Cordeiro's Telemeter. The Development of Smokeless Powder. Firing Big Guns.

SEPTEMBER 12. Collision with an Iceberg. The Bazin Roller Boat. Propulsion of Barges.

SEPTEMBER 26. Bids on the Three New Battle-ships.

PROCEEDINGS OF THE AMERICAN PHILOSOPHICAL SOCIETY.

VOL. XXXV., JANUARY, 1896. Demonstration of the Röntgen Ray. The Identification of Colored Inks by their Absorption Spectra.

BULLETIN OF THE AMERICAN GEOGRAPHICAL SOCIETY.

VOL. XXVIII., No. 2, 1896. The Alaskan Boundary. Record of Geographical Progress: the Swedish Expedition to Terra del Fuego; The Danube Ship Canal.

The lower Danube is about to be opened to navigation by large boats by the completion of the ship canal at the Iron Gates.

ELECTRICAL ENGINEERING.

AUGUST, 1896. Fly-wheels for Steam Engines.

SEPTEMBER. The Manufacture of Wire, Galvanization Stranding of Copper Wires, Gauging.

PROCEEDINGS OF THE AMERICAN SOCIETY OF CIVIL ENGINEERS.

SEPTEMBER, 1896. Experiments on the Protection of Steel and Aluminum exposed to Sea Water.

Gives results of tests of various coatings and pigments. Fifty-four steel plates and thirty aluminum plates coated with various paints and enamels were immersed in sea water for six months, then removed and their condition investigated. The results are given in detail by A. H. Sabin, who in conclusion states with reference to the aluminum plates: "The more nearly pure the aluminum the less it seems to need protection. The series which contain large amounts of copper or zinc are the most difficult to protect; corrosion seems to progress rapidly where the sea water gets the slightest admission, and it throws off the coating no matter how impervious the latter may be."

ELECTRICAL DOINGS.

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SEPTEMBER. Cable Laying on the Amazon River.

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AUGUST. Electricity in the United States Navy. Efficiency of the Steam Engine. Faults in Dynamos. Lessons in Practical Electricity.

SEPTEMBER. Electro-magnetic Deflection of Rifle Balls. Faults in Dynamos. Lessons in Practical Electricity.

ELECTRICAL ENGINEER.

SEPTEMBER, 1896. Electric Turret Gear for French War Ships. A New Finding Light for War Vessels.

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AUGUST 29, 1896. The Engines of the Janus. Boilers of the Germanic. Unusual Corrosion of Marine Machinery. Management of Marine Engines.

SEPTEMBER 12. Boilers of the Germanic. Three New Battleships. Early American Shipbuilders. Management of Marine Engines.

SEPTEMBER 26. Marine Engine Design of to-day. Management of Marine Engines.

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JULY-AUGUST, 1896. The Naval Attack on Sea-coast Fortifications. The Tram-chronograph. The Principles of War. Garrison Artillery Warfare.

JOURNAL OF THE AMERICAN SOCIETY OF NAVAL ENGINEERS.

AUGUST, 1896. Contract Trial of the United States Coastline Battle-ship Oregon. Compound Marine Boilers. Water-tube Boilers. Circulation in Water-tube Boilers. Discussion of the Three Foregoing Papers on Water-tube Boilers. Measurement of Feed and Circulating Water, etc., by Chemical Means. Development in Design and Construction of German Men-of-war. Comparison of New British Cruisers with those Building at Barrow. Use of Electricity on board Ships.

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JULY, 1896. The Transformation of the Energy of Carbon into other Available Forms. Return Circuits of Electric Railways. Utilization of the Anthracite Culm Heaps in the Production of Power. Mechanical Conceptions of Electrical Phenomena.

AUGUST 1. The Fire-retarding Qualities of Wired Glass. The Conditions which cause Wrought-iron to be Fibrous and Steel Low in Carbon to be Crystalline.

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JULY 4, 1896. Work for the New Fiscal Year. Revised Naval Regulations. Tactics of the Future.

JULY 11. The New Army Rifle. Sights for Military Rifles.

JULY 18. The Savage Rifle. Arbitration Treaty with England. What the Country owes to West Point. War Terrors for Spain. French Opinion of the Holland.

JULY 25. Smokeless Powder in War. Disciplining Volunteers. Trial of Automatic Gun.

AUGUST 1. America and England. Naval Manœuvres proposed. The Study of War made in Germany. Savage Attack upon the Savage Gun.

AUGUST 15. Balloon Experiences in War Time. Wanted, a Military War College.

AUGUST 29. Smokeless Powder.

SEPTEMBER 5. Foreign Affairs.

SEPTEMBER 12. The Old and New Brooklyn. Electricity in Naval Life.

ENGINEERING NEWS AND AMERICAN RAILWAY JOURNAL.

JULY 9, 1896. Methods in use for the Analysis of Ores, Pig Iron and Steel by the Carnegie Steel Co.

JULY 16. Uniform Methods of Testing Iron and Steel.

JULY 23. The New Rifle for the New York Militia (illustrated). The Expenditures of the United States in Eleven Years (illustrated). Tests of Non-conducting Material for Boiler Coverings (illustrated).

AUGUST 6. Testing Machine of 200,000 lbs. Capacity for the University of New York (illustrated).

AUGUST 27. Standard Specifications for Steel. Association of American Steel Manufacturers (illustrated). A New Single-acting Compound High-speed Engine (illustrated). A German System of Metal Stair Construction (illustrated).

SEPTEMBER 3. The Great Hoisting Engines for the Anaconda Copper Mining Co (illustrated).

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JULY, 1896. Ten Years of Riot Duty. Military Administrations. Changes in the Character of War. Infantry Attack Formations. Discipline in the National Guard. Practice Marches of Light Artillery. Uses of Cavalry in Time of Riot.

SEPTEMBER. The Elevation of Sites for Batteries. Preparation of the Infantry Soldier. The Heavy Artillery of the Future.

THE UNITED SERVICE.

JULY, 1896. German Army. What our Cavalry in Mexico did and did not do. The Olympic Games. A Naval Utopia.

AUGUST. An Answer to "The First Six Weeks of McClellan's Peninsular Campaign." An Incident in the History of the Dying Confederacy. German Army.

SEPTEMBER. The New French Naval Programme. The Campaign of Chickamauga. The Human Animal in Battle. A Summer Cruise with Farragut.

CASSIER'S MAGAZINE.

AUGUST. Brains in Modern Steam Engine Building. Five-crank Marine Engines. The Future of Power Development.

SEPTEMBER. Sir Henry Bessemer. Condensers for Steam Engines. Filtering Feed Water for Steam Engines.

[FOREIGN.]

JOURNAL OF THE ROYAL UNITED SERVICE INSTITUTION.

JULY, 1896. The Study of Naval History. The Framing of Orders in the Field. Moltke's Projects for the Campaign of 1866 against Austria. The Operations of the Bulawayo Field Force in March and April, 1896.

AUGUST. Elements of Force in War-ships. Von Löbell's Annual Reports on the Changes and Progress in Military Matters during 1895. The Electrical Fittings of the French Coast-defense Battle-ship Bouvines.

The electric power is furnished by four dynamos, type H_8, by Sautter, Harlé & Co. Each machine furnishes a current of 400 ampères, with a difference of 80 volts at the terminals. The four machines are placed in one compartment under the protective deck, and ventilated by a large air tank. The electricity is transmitted to the various apparatus by means of four switch-boards, viz. (1) for the distributing mains; (2) electric lighting, incandescent; (3) motors; (4) projectors.

The duties of the different installations are as follows: (1) For illumination complete; (2) for control of steering engine and helm indicator; (3) working eleven winches for ammunition hoists; (4) eight ventilators for bunkers and forward and after compartments; (5) five 60-cm. projectors, each fitted to control at a distance.

SEPTEMBER. Two Years in Australian Waters. The Difficulties of the Tactical Defensive and how to meet them. Analogy between Tactics of Field Artillery and those of the other Arms.

UNITED SERVICE GAZETTE.

JULY 27, 1896. Progress in Battle-ship Construction.

JULY 4. The Electric Fencing Umpire.

On the 24th ult. a very interesting exhibition was given by several skilled fencers at Bertrand's Fencing School, Warwick Street, Regent Street, of the "Electric Umpire." The apparatus consists essentially of two electric alarms, of different notes, arranged to ring continuously when once started, two fencing jackets, with wire gauze fronts, two foils with specially constructed handles, and the necessary wires, etc. When a proper point is made, one of the fencers and the foil of his adversary are in the same circuit. A very light flexible wire cord, containing two conductors, connects each fencer with the bell and battery, which are fixed to the wall above and behind his head. Each foil blade is mounted on a spring so that to complete the circuit it must be forced into the handle a sixteenth of an inch, which can only be done by pressure on the metallic end of the button. The slack of the wire cord is kept out of the way by passing it over a pulley, and it is then kept moderately taut by a small weight (of about six ounces) fastened to another pulley, which travels on the bight of the cord. As only half this weight is borne by the fencer it can easily be understood that in practice the existence of the cord and weight is entirely forgotten and ignored. We made particular inquiries on this point of several of the competitors, and they assured us they were quite oblivious of the existence of the cord.

It is impossible that the bell should ring except under the following conditions:

1. The hit must be made on the part of the opponent's jacket on which alone hits count.
2. It must be a true point.
3. It must be delivered with sufficient force to compress the spring, and so drive the foil blade back in the handle.

Therefore, flat strokes, flicks, and "passes" are not recorded; nor are hits off the target. The duty of the judge is thus practically narrowed down to listening for the bells. It is, of course, far easier to judge which of the two sounds began first than it is to judge by the eye which of two strokes occurred first, especially as it is almost impossible for the same pair of eyes to closely watch two jackets. The judge would, of course, also be needed to decide in case of a claim by a fencer whose bell has sounded, that he had previously hit his adversary on the arm or leg, or mask, etc.

Boilers, Subsidized Steamers, and Naval Education.

JULY 18. The Naval Manœuvres. German, French, and Russian Systems of Attack.

JULY 25. The Manning of the Fleet. A New Austrian Rifle. The Need of Increasing the Personnel of our Fleet. The Naval Manœuvres.

AUGUST 1. The Naval Manœuvres. Design and Construction of German War Vessels.

AUGUST 8. The Naval Manœuvres.

AUGUST 15. On Moral Influences in War—I. Our Naval Needs.

AUGUST 22. Asiatic Crews in British Ships. On Moral Influences in War—II.

AUGUST 29. The Classification of War Ships—I. The System of Manning our Navy.

SEPTEMBER 5. The Classification of War Ships—II. Naval Uses of Electricity—I.

SEPTEMBER 12. The Classification of War Ships—III. Naval Uses of Electricity—II.

ENGINEERING (LONDON).

JUNE 26, 1896. Our New Cruisers (illustrated). Coast and Lighthouse Illumination in France (illustrated).

JULY 3. Launches and Trial Trips. The Niclausse Boilers of the Friant. The French Battle-ship Jauréguiberry (illustrated). The Classification of War Ships.

JULY 24. H. M. Torpedo-boat Destroyer Janus (illustrated). Microscopic Internal Flaws Inducing Fracture in Steel (illustrated). Torpedo-boat Destroyers and the Yarrow Boiler.

JULY 31. H. M. Torpedo-boat Destroyer Janus (illustrated). Water-tube Boilers and Feed Distribution (illustrated). Unusual Corrosion of Marine Machinery.

AUGUST 7. The Naval Construction Company's Works at Barrow (illustrated). The Great Sea Waves in Japan. The Drummond Castle.

AUGUST 14. The Naval Construction Company's Works at Barrow (illustrated). An Improved Stang Planimeter (illustrated). Yarrow's Feed Apparatus.

AUGUST 28. Large Explosions and their Radii of Danger. The Naval Construction Company's Works at Barrow (illustrated). H. M. S. Venus. The Nippon Yusen Kwaisha Timbers in the Straits Settlements.

SEPTEMBER 4. Large Explosions and their Radii of Danger. Caissons for the New North Docks, Liverpool. The Reorganization of the French Marine.

SEPTEMBER 11. The French Naval Manœuvres. Edward's Air Pump.

THE LONDON ENGINEER.

JUNE 26, 1896. The Drummond Castle Disaster. The Foudroyant. On Signs of Weakness in Tank Steamers. Recent Improvements in Docks and Docking Appliances (illustrated).

JULY 3. Herr Krupp on the Perforation of Steel Armor. Marine Boilers, particularly in reference to Efficiency of Combustion and Higher Steam Pressures (illustrated). Notes on the Maintenance and Repairs of Marine Boilers.

JULY 10. The Foudroyant in Nelson's Time (illustrated).

JULY 17. New Engines of the White Star Liner Germanic (illustrated). Armor-plated Torpedo-boats. German Shipbuilding.

JULY 24. American Shipbuilding. The Working of Aluminium: Melting and Casting. Practical Tests of the Krag-Jörgensen Rifle in the U. S. Army. Atlas Bronze (illustrated).

JULY 31. Steam Pumping Arrangements in Screw Steamers, No. 1 (illustrated). The Argentine Cruiser Buenos Aires (illustrated). The Sante Fe Torpedo-boat Destroyer (illustrated). Ventilation in War Ships. Trial of a Torpedo Gunboat for the Chilian Navy.

AUGUST 7. The Drummond Castle Disaster. Fleet Inspection by Li Hung Chang at Spithead. American Plate Trials (illustrated).

AUGUST 14. Warping Gear, s. s. Algoa (illustrated). The New Battle-ships. Harbor Works at Colombo. H. M. S. Terrible.

AUGUST 21. Cosen's Spherical Water-tight Bulkhead Doors.

AUGUST 28. Captain Gaynor's Automatic Sight (illustrated). Improved Water-gauge Fittings (illustrated).

SEPTEMBER 4. H. M. S. Caesar. The Progress of the Japanese Battle-ship Friji. Pneumatic Dynamite Guns at San Francisco.

SEPTEMBER 11. Official Speed Trials of H. M. S. Victorious.

SEPTEMBER 18. Torpedo-boats for Chilian Navy. American Merchant Steamers as Cruisers.

THE STEAMSHIP.

JULY, 1896. Wimshurst's improved Ship Clinometer (illustrated). Marine Boiler Explosions. A New Stop-valve. Modern Steamships and Navigation. Wimshurst's Gradient or Heel Indicator (illustrated). Superheated Steam. American Tests for Boiler Plates.

AUGUST. Marine Boiler Explosions. Casey's Bulkhead Water-tight Doors. Maintenance and Repairs of Marine Boilers (illustrated). Launch of H. M. S. Isis at Govan. The Holland Submarine Torpedo-boat (illustrated). Copper Fire-box Plate Trimming Machine (illustrated). Babcock and Wilcox Water-tube Boilers (illustrated).

SEPTEMBER. Screw Propulsion by Non-reversing Engines (illustrated). Triple-expansion Engines of the Yacht Josephine (illustrated). Speed Control of Modern Steamers (illustrated). The proposed New Regulations for Marine Engineers. Corrosion of Marine Machinery. Trials of First-class Cruiser Terrible. Marine Boiler Explosions. The Trials of the New Cruiser Venus.

MORSKOI SBORNIK (RUSSIAN).

APRIL, 1896. Naval Operations during the Chinese-Japanese War. Present-day Military and Naval Armaments with Magazine Small Arms. English Naval Budget, 1896-7. Practical Method of Constructing approximately the Theoretical Curves of Ships. The Working of Metals with the Electric Current. Notes on the Saghalien Channel.

MAY. Naval Operations during the Chinese-Japanese War. Theory of Naval Tactics (trans. from German). Technical Review of Modern Naval Engagements. Law of Similarity in various Problems of Ship Construction. Fighting Speed of Ships. Comparison of Steam and Electric Mechanisms. Review of the Results of the Hydrographic Expedition to the Mouths of the Rivers Yenesei and Obe in 1894-5.

JUNE. Participation of the French Fleet in the Madagascar Expedition. On board the Steamer City of Peking. Theory of Naval Tactics. Technical Review of Modern Naval Engagements. The Iceboat Murtaja.

JULY. The Russian Fleet in the Reign of Nicholas I. Naval Operations during the Chinese-Japanese War. Tactical Considerations influencing Future War Ship Construction. Means of Preserving the Integrity of Water-tight Bulkheads upon Collision. Comparison of Steam and Electric Mechanisms. The Solarometer.

J. B. B.

MITTHEILUNGEN AUS DEM GEBIETE DES SEEWESENS.

VOL. XXIV., NO. 7. Solution of Problems in Navigation by Tables of Meridional Parts. The Clouth Diving Apparatus.

In this diving apparatus improvements have been made in the diver's suit. The helmet is oval in shape, shaped more to the skull than the old spherical form, permitting more freedom to the head. The central glass light is so fitted that the diver can secure it in place, or remove it, himself without the assistance of a second man. The upper border of the rubber suit, which latter consists of a layer of rubber between two layers of vulcanized cotton, is welted. These welts fit into the metal ring of head and shoulder-pieces, making an hermetically sealed joint. A number of improvements have been made in the air tank, both as to shape and arrangement and fitting of the valves. The air pump is provided with a cooling pump for the purpose of keeping the air at constant temperature, specially desirable in the tropics. The hose to be lined with canvas lining, as a means of insuring good air.

The air tube is fitted with a patent coupling, which the diver can quickly uncouple in case it becomes necessary for him to disconnect himself from the air tube. In this case the air stored up in the tank will supply him for 10 minutes longer while rising to the surface. An automatic valve regulates the air pressure, and another closes automatically, preventing entry of water when the tube is uncoupled.

The breast and back leads are better placed and secured than in the old suits. The belt is broader; fitted to carry a handsaw, a knife, besides the

necessary tools. The belt carries the uncoupling arrangement, also fastenings for the life line and signal line.

The diver's shoes are also improved, so that in case of necessity for rapid rising they can be instantly cast by the wearer. An electric lamp, which hooks into a hook under the front side of the helmet, completes the outfit.

Cost of English War Ships. The French Naval Budget for 1897.

No. 8. Fighting Values of Ships depending upon their Artillery alone. The Polyconic American Charts. On the Value of Torpedo-boats in Time of War. Improvements in Water Tubular Boilers. Harbor Works at Libau, Russia. The Italian Naval Budget, 1896-97. H. M. Torpedo-boat Natter.

This first-class torpedo-boat of 152 tons displacement made an average of 26.5 knots in a 3 hours' trial with 26.2 tons of coal on board. The total coal capacity is 30 tons, radius of action with 12 knots speed is 2500 sea miles. Armed with 3 deck launching tubes, 18-inch, two forward, one aft, and two 47-mm. R. F. guns forward.

No. 9. Fighting Values of Ships depending upon their Artillery alone. Timely Reforms in the Study of Navigation. A New Invention in Torpedoes.

Mr. L. Obry, of Trieste, late of the Imperial Austrian Navy, has invented an apparatus for the automobile Whitehead torpedo which prevents lateral deviations from the line in which launched.

The apparatus consists in general of a gyroscope, which is put in operation at the moment of launching and is free to act as soon as the torpedo is launched; a steering motor controlled by the gyroscope, and a pair of movable side rudders, which take the place of the present vertical vanes. If the course of the torpedo be altered through external or internal causes, a change in the axis of the gyroscope results, causing it to react upon the motor, which will act upon the rudders, setting them in the proper direction to bring the torpedo back to its course. These recurring effects will make the path, as viewed from above, of the torpedo slightly undulating. The advantage of the apparatus is its lightness, and it may be easily attached in any Whitehead torpedo.

Experiments made have been highly successful. Torpedoes were fitted with the apparatus and were launched from fixed cages as well as in broadside from torpedo-boats going at 25 knots, and purposely under adverse circumstances. The tests showed wonderful accuracy, and a marked reliability in comparison with torpedoes launched at same time but not fitted with Mr. Obry's invention. The ranges were from 800 to 2000 meters.

Budget of Imperial Austrian Navy for 1897. Torpedo Cruiser Magnet. Development of Shipbuilding in Germany. Bazin's Roller Boat. French Melinite Shell.

Gives cut of fuze and description. H. G. D.

ANNALEN DER HYDROGRAPHIE UND MARITIMEN METEOROLOGIE.

Vol. VI., 1896. Notes on the Harbors of Cape Haytien, of

Punta Arenas, Potrairo Bay, and Cocos Bay. St. Elmo's Fires at Sea. Equipment of U. S. S. Blake for Anchoring at Sea and Current Observations.

VOL. VII. Typhoon on Southeast Coast of Japan in July, 1895. Hail Storms at Sea.

PROCEEDINGS OF THE ROYAL ARTILLERY INSTITUTION.

JULY, 1896. Ammunition Columns and Parks, considered with reference to the Replacement of Ammunition, Horses and Men during and after an Action.

AUGUST. The Chino-Japanese War.

MILITÄR WOCHENBLATT.

NO. 53, JUNE 13, 1896. A Contribution on improved Targets for Field Artillery.

NO. 54. British Attempt of a limited Mobilization.

NO. 57. Spanish War Budget, 1896-97.

NO. 58. German Southwest Africa. A Society for Study of Weapons.

NOS. 60 and 61. Are Bicyclists useful for Fighting Purposes? Instructions in Russia for establishment of a Carrier Pigeon Service.

NO. 65. German Southwest Africa. English Carrier Pigeon Service.

Up to the present the English Government had not interested itself in the carrier pigeon service. Experiments had been carried on by naval officers at Devonport at their private expense. The results were satisfactory. The number of birds was 60, trained for the neighborhood of Plymouth; the longest flights made were from Wolf Rock, Land's End, about 75 miles. On the strength of these results the Admiralty has at last decided to take charge of the cote. A torpedo-boat or torpedo-catcher will be used to further experiment and develop the flights.

Purchase of War Material by Spain.

Five million cartridges were ordered from a French firm, to be delivered by instalments in three months time. A commission has been sent to Germany, France, England and Italy for purchase of balloon outfits.

NO. 71. The Swiss Magazine Carbine.

NOS. 75 and 76. Projectile and Caliber of a New Field Artillery Piece. The Reserve Cruisers of the United States. Italian Fleet Manœuvres.

NO. 81. Counter Attack of Infantry on the Defensive. Pigeon Service in Italy.

During the siege manœuvres of Nava a regular carrier pigeon service was used between this place and Rome. Intermediate stations were at Alexandria, Piacenza, Bologna and Ancona.

During the fleet manœuvres several hundred birds from Spezzia wil be taken on board the flagship Sicilia to carry messages from the fleet tc the shore stations.
H. G. D.

MARINE RUNDSCHAU.

No. 7, July, 1896. Ironclads in Action. Proposed Coast-defense System. The Kiel Exposition. Extract from Report oi the Meteor, Police Boat for Protection of the North Sea Fisheries. Trial Trips of the Kaiserin Augusta in 1895. Trafalgar (concluded). Naval Notes.

No. 8, August. Early Stages of the Growth of the German Navy. Burning of Coal-dust. Development of Shipbuilding in Germany. The Kiel Exposition. Herring Nets. Naval Notes.

No. 9, September. Marine International Law in Times of Peace.

A short digest on international rules governing the rights of merchant and war vessels in times of peace, of ceremonies to be observed, regulations governing exchange of courtesies, etc., arranged under headings as follows: I. Sovereignty of the sea; II. Ships in general; III. Merchant ships; IV. Ships of war (defining exterritoriality, right of asylum, free ports, general privileges); V. International courtesies; VI. Piracy, coast rights, slave trade and ocean highways; VII. Means for the prevention of wars.

French Views on the Instalment and Use of Artillery on board Ironclads.

The author considers the subject under headings, viz. 1. The manner of placing a battery and its armored protection; 2. The different forms oi French projectiles; 3. Range tables and their application; 4. Probability of fire at sea; 5. Various firing methods; 6. The tactical use of artillery.

On the Application of the Hahn Range Finder to determine the Lateral Deviation due to Wind and Speed of Target. Continuous or Alternating Current on board Merchant and War Vessels. Extract of Report of the Meteor.

DEUTSCHE HEERESZEITUNG.

No. 48, June 13, 1896. Military Telephoning.

No. 51. Japanese Hospital Transport System.

No. 53. Li Hung Chang and the Fate of his German Ships of War.

No. 59. Report of Captain G. F. Elliot on the Japanese Soldier.

No. 61. Cavalry against Cavalry. The Italian Cei Rifle.

The well known property of this magazine rifle, invented by Capitan Cei, an Italian officer, is that the lateral pressure of the powder gases on firing act upon the magazine mechanism in such a manner as to automatically load and cock the piece so that the marksman has to merely

pull the trigger. In consequence of the almost incredible rapidity of fire thus acquired the gun practically takes the place of a complicated gatling or machine gun. Continued experiments are being conducted with this weapon on board of the Italia, resulting in some changes in the mechanism. It is quite probable that its introduction into the Italian Navy may take place.

No. 63. Foreign Navies in 1895.

No. 64. English Wharves and Docking Facilities.

No. 67. Battles in coming Wars. The Defenses of Barcelona.

With the prospect of a possible conflict with the United States over the Cuban question, the Spanish Government has issued orders to proceed at once with the long-planned work of fortifying the harbor of Barcelona and the adjacent coast-line.

Barcelona, at present, is protected merely by the old fort of Montjuich, commanding the harbor, and the three batteries Reale, Alfonso, and Buena Vista, which are to receive new armaments.

The Engineer Corps has received orders to at once begin the erection of eleven batteries fitted for disappearing guns. These batteries to be armed with 9½-inch and 12.6-inch Hontoria guns, which with a range of 11 miles will be able to sufficiently guard the harbor of Barcelona against attack and to prevent any landing of forces in its immediate vicinity.

Nos. 70 to 74. Facts on the First and Second Lines in Strategy. Artillery in Battle. New Swiss Rifle. H. G. D.

LE YACHT.

June 18, 1896. The Gunnery School. Trials of the Jauréguiberry.

June 20. Liquid Fuel. Results of Armor Tests at Cherbourg. Launch of the D'Entrecasteaux.

June 27. The Foundering of the Drummond Castle.

July 4. Latest Progress of Artillery and Armor in the Navy. The Torpedo-boat Destroyer Cassini. Naval Manœuvres.

July 11 and 18. The Naval Manœuvres (French and English). The British Ironclad Renown. Gunnery Ships Couronne and Calédonien.

July 25. Defense of the Coast. The Naval Manœuvres (French and English).

August 1. The Shei-Po Affair. The Doris. The Naval Manœuvres.

August 8. Naval Manœuvres (French and English). The Shei-Po Affair.

August 15. The Ernest Bazin.

The rolling ship Ernest Bazin will be launched August 19. She will be 126 feet long, 38 feet beam, and a displacement of 246 tons. If the theories of the inventor are realized the vessel will attain a speed of 22 to 25 knots, with 650 horse-power.

The Shei-Po Affair.

AUGUST 22. The Destroyers. The Launch of L'Ernest Bazin. The Armored Cruiser Amiral Pothuan. The Shei-Po Affair.

AUGUST 29. The United States Navy. The Shei-Po Affair.

SEPTEMBER 5. Shipbuilding in Germany. Turret-deck Stmr. Forest Abbey. New Torpedo Destroyers for Chili and Turkey.

SEPTEMBER 12. On the Article entitled "Observations on the Battle of the Yalu." Launch of the St. Louis.

SEPTEMBER 19. Naval Tactics. On the Article entitled "Observations on the Battle of the Yalu." Launch of the Russian Armor-clad Rostislau. H. G. D.

RIVISTA MARITTIMA.

MARCH, 1896. Strategic Use of Torpedo-boats. The Niclausse Boiler. Alternate Electric Currents, and their general Study with regard to the Geometric Process (supplement). Notes on the Naval Organizations of the Principal Nations.

MAY. Measurements of Fuel Consumption applied to Marine Boilers. Determination of Time by means of Observation of the Horary Stars in the Vicinity of the Pole. On the Use of Ordnance in a Naval Action.

JUNE. A Note on the Rôle of Torpedo-boats. Pleasure Navigation (yachting) (end). (Supplement) Notes on the Naval Organizations of the Principal Nations.

JULY. Notes and Comments on Ship Ventilation.

AUGUST-SEPTEMBER. Boilers: Systems Oriolle, Du Temple, and le Normand. The Niclausse Steam Generators on board the Friant. J. L.

RIVISTA DI ARTIGLIERIA E GENIO.

FEBRUARY, 1896. On the Resistance of Air to the Flight of Projectiles (continued). Calculation and Regulation of the Action of Explosives.

MARCH. On the Resistance of Air, etc. Graphics of Convergency. On the Construction of Military Wagons. Firing against Dirigeable Balloons.

APRIL. Apropos of a Contribution to the Rational Solution of the Ballistic Problem. The Crehore and Squier Photochronograph based on the use of the Magnetic Rotary Polarization.

MAY. Apropos of a Contribution, etc. (continued). Field Artillery in Action (continued). The Military Engineer Corps in Africa. Automatic Small Arms of Gl. R. Wille.

JUNE. A Study of the Elastic Resistance of Tubes with Circular Sections. System of Sights for Training Field and Siege Guns.

JULY. Coast Defense and Attack. J. L.

LE MONITEUR DE LA FLOTTE.

JUNE 20, 1896. The Colonial Army.

A bill having for its object the transfer of the Colonial Army from the War to the Navy Department will be introduced in the French Chambers during the next session. The proposed change will, it is thought, prove beneficial, as it will free both arms of the service of a cause of friction from which the past has not always been exempt.

JUNE 27. Speed and Endurance.

M. Ferrand, the well known French naval engineer, has just published in pamphlet form a lecture he delivered before the "Société d'Encouragement pour l'Industrie Nationale," on the Forban, and the progress made during the last decade in the construction of torpedo-boats. In this clear and able exposé of a question of the highest interest, M. Ferrand points out the dangers one subjects himself to in seeking after superiority of speed as being of paramount consideration to the exclusion of all others.

JULY 4. Naval Mutual Aid Association.

JULY 11. Privateering.

Lieut. Duboc, expanding upon a theme often discussed of late, has undertaken to prove in a pamphlet entitled "England's Weak Point," that if ever we (the French) became involved in a war with our neighbor across the Channel (which God forbid), we must remember that England's most vulnerable point is her commerce on the seas, and a naturally indicated target for our blows.

JULY 18, 25, and succeeding Nos. The Naval Manœuvres.

AUGUST 29. The Ernest Bazin.

The trials of the E. B. on the open sea will take place in the latter part of October, and if successful, the construction of a larger craft upon the same plans will be immediately commenced.

Transatlantic Mail Steamers.

The Compagnie Générale Transatlantique is contemplating the building of three large additional steamers to their fleet, in order to compete with the fastest boats of other companies; and with this object in view has by anticipation asked the Government to renew the present contract, which expires in 1901. In that case the docking facilities at Havre would have to be increased. J. L.

REVUE MARITIME.

JUNE, 1896. Armor Plates and Guns in April, 1896. Diseases of Sailors and Nautical Epidemics (continued).

The fifth chapter of this interesting study, entitled "First Succors to the Sick and Wounded," is deserving of particular notice. It describes

in a clear and comprehensive form the first care to the sick and wounded, and is in fact a "Medical Guide" for the naval officer. As a rule, torpedo-boats, scouts, and other similar crafts carry no surgeons. On the other hand the doctor may be temporarily absent from the ship, with a land expedition lasting two or three days for instance. In the interval a case may arise when it becomes urgent to apply a first treatment. The Guide then comes into use. It will be found no less valuable on board merchantmen and fishing boats.

JULY. Scintillation of Stars as observed on board the Durance in 1894-95. Diseases of Sailors and Nautical Epidemics (end).

AUGUST. Study of the Relative Movements in connection with the Combat between two Ships.

The object of the study is, by reasoning upon straight routes or routes filling well defined conditions, to evolve from the *ensemble* of the relative or absolute movements a strictly mathematical law. J. L.

SOCIÉTÉ DES INGÉNIEURS CIVILS.

APRIL, 1896. The Navy Matériel in the Recent Conflict in the Far East, and principally in Japan, by M. L. de Chasseloup-Laubat.

M. de C. L., after referring to the importance of the events in the Orient, gives a rapid résumé of the theory of the stability of the ship, in order to fix the bases of the arguments he makes later on upon the conditions to be filled by fighting ships, cruisers as well as armorclads. He then describes the fighting matériel of the navies of China and Japan, setting off the general ideas that prevailed in the organization of the two fleets. Then follows a short narrative of the battle of Yalu, concluding with a statement that the Japanese victory was due, in the first place, to the greater valor of the navy personnel of the Mikado, and in the second place, to the superiority of the formation of line ahead (column) over that of line abreast. That idea he develops in the latter part of his work, and examines successively the various cases that may present themselves when sailing in squadron, in time of peace as well as in war time: a lurch, an accident to the engine, or an attack from torpedo-boats. He examines in detail those different cases with squadron standing in column or line, and points out how much more the last formation increases the chances of most disastrous collisions. He terminates with general remarks upon the various types of fighting ships, and reaches the conclusion that there must be a clear separation between the battle-ship and the cruiser. Cruisers to be of the Chanzy class modified battle-ships, monitors with topgallant forecastle (*teugue*).

A Note on the Large Cruisers of the Different Navies, by M. G. Hart.

The recent publication of a very interesting book by Rear-Admiral E. Fournier, the present Superintendent of the Naval School of War, reopened the discussion in regard to the types of vessels that should compose the French war fleet. The ever increasing additions to the already powerful fleet of England lend new interest to this question. In his book, "The Necessary Fleet," Admiral Fournier, basing his hypothesis on the maritime struggle between France on one side and

England or the Triple Alliance on the other, easily demonstrates that the present French fleet with its diversity of types afloat, so cumbersome when navigating in squadrons, would prove inadequate for the services expected of it. He then examines the different possible combinations of the European navies, and reaches the conclusion that whether defeated or victorious, the French fleet would be powerless to destroy the enemy's commerce or keep open the communications with the colonies.

In reality the command of the seas would belong to the isolated cruisers.

France possesses, it is true, a number of fast cruisers, but in most cases their displacements are small, and in the least heavy sea they are apt to lose a great part of their speed, besides being deficient in offensive and defensive powers.

The causes of this situation he attributes to the long hesitations of the Admiralty, who for twenty years opposed projects founded on principles universally adopted now-a-days.

In the face of this situation, M. Hart undertook to examine what has been accomplished by other nations, in order to determine the types of ships most in accord with our naval situation and our finances.

He describes successively twenty types of cruisers, which he ranges in two large classes: the protected cruisers on the one side and the armored cruisers on the other, interjecting the remark that the latter class is a misnomer, their armors being in most cases only partial and very slight. He indicates the differences existing between those various types, giving the ratios of their dimensions, which in a way form their characteristics, as well as their systems of construction, their protections, and their armaments.

He concludes that two types of cruisers appear to him necessary:

(1) The protected cruiser, with a high speed, capable of being sustained for a great length of time, fitted with light masts, enabling it to cruise for days without burning much coal, and designed to prey upon the enemy's commerce.

(2) The armored cruiser, with a tolerably fair speed, armored from end to end, with protected superstructures capable of challenging in a measure high explosive projectiles, and intended to operate in squadron as well as in distant missions where a show of force might be necessary.

M. Hart indicates the types which come nearest his conception, and points out the modifications he judges necessary in them.

MAY. Electric Locomotives. J. J. Heilman's System.

JUNE. Writing Machines (type-writers). Application of Pneumatics to Horse or Horseless Vehicles: Results of the Application. Explosion of a Boiler with Removable Interior Furnace. Mechanics of the Material Systems. Possible Extension of the various Coal Fields of France. J. L.

REVISTA MARITIMA BRAZILEIRA.

JANUARY, 1896. Influence of Naval Power on History. Cruisers: their Rôle; Conditions they must fulfill. The Necessary Fleet, by R.-Adm. Fournier.

FEBRUARY. The War Navies of the World in 1895. Influence of Naval Power, etc. Rectilinear Trigonometry (continued).

MARCH. Maritime Inscription. Recruitment of the Navy Personnel. A Comparison between the Naval Powers of England and the United States. Influence of Naval Power, etc.

APRIL. The Composition of War Fleets. Submarine Boats in the United States.

MAY. Reforms in the Mobile Defenses. The New Navy of the United States. Influence of Naval Power, etc. Determination of the Fighting Capacities of a Vessel. Rectilinear Trigonometry (continued).

JUNE. Rôle of the Torpedo-boat. The New Navy of the U. S. The Problem of the Fighting Ship. Spheric Trigonometry.

JULY. The Naval Fight of the Riachuelo. Organization of the Maritime Prefectures of the Republic. J. L.

REVISTA TECNOLÓGICO INDUSTRIAL.

MARCH, 1896. Development of the Experimental Study of the Steam Engine. Altimetry: Measurement of Heights by means of the Barometer, Hipsometer, and Photogrameter. Heights of Several Points in Catalonia. The Oregon (end).

APRIL-MAY. "Ginematics." Moisture in Cotton Spinning.

JUNE. A Study of Rain Water in connection with the Bodies it contains.

JULY. A Visit to the Artesian Wells of the Casanovas. Agricultural Colony of Prat del Lobregat (province of Barcelona).

AUGUST. Alimetry: Measurement of Heights, etc. Characteristic of Drinking Water. J. L.

BOLETÍN DEL CENTRO NAVAL.

JANUARY, 1896. The Belleville Steam Generators.

A minute description of the Belleville Works, situated at St. Denis, near Paris. (See "The Belleville Boiler," No. 23 of the Proceedings.)

Modern Naval Tactics.

FEBRUARY-MARCH. The Belleville Generators (continued). Steel for Ordnance (continued).

APRIL-MAY. Gun-cotton in France.

A description of the Angouleme Works, where it is manufactured.

J. L.

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SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1897.

A prize of one hundred dollars, with a gold medal, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1897. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Board.

3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.

4. Any essay not having received honorable mention, may be published also, at the discretion of the Board of Control, but only with the consent of the author.

5. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

6. All essays submitted must be either type-written or copied in a clear and legible hand.

7. The successful competitor will be made a Life Member of the Institute.

8. In the event of the Prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of a gold medal.

By direction of the Board of Control.

H. G. DRESEL,

Lieut., U. S. N., Secretary and Treasurer.

ANNAPOLIS, MD., *February 12, 1896.*

And yet though the rule is true, a variety of causes may alter or suspend it. Treaties may do this; the necessity of self-defense may do this; the exigencies of a country's policy may attempt this.

Then, too, there may be search in time of peace on suspicion of piracy, for a portion of your duties, gentlemen, lies in the policing of the seas. Now the modern pirate does not, as a rule, hoist that black flag and Jolly Roger in the presence of a ship of war, which, as every one knows, are essential to his peace of mind. On the other hand, if you search on suspicion and find your pirate to be a harmless trader, you may be personally liable in damages. It will appear, therefore, I think, that there are, if not genuine exceptions to the rule that the right of search is a belligerent right in war only, at least such real or attempted modifications of it as to be worthy of our study. We may not succeed in laying down a hard and fast law, but I trust that we may call attention to some historical aspects and some modern phases of the question which will not be without interest.

During the early years of this century, and in truth for some time before them, there was one matter which embittered our relations with England more than all others—the impressment of seamen on board American ships. The exasperation which sprang from this practice influenced our national policy in another question for nearly fifty years.

The legal basis for the claim to impress seamen out of foreign ships was the doctrine of the indelible allegiance of every British subject to the Crown. Neither emigration, naturalization, foreign marriage, or any other circumstance could wipe it out. This led to some curious inconsistencies. Thus an English woman marrying a foreigner remained an English subject; a foreign woman marrying an Englishman became an English subject.

An Englishman naturalized abroad, acquired thereby obligation of military service, while still retaining the same obligation to the country of his origin. So that in case of war between them, to one of the two he must of necessity prove a traitor. This theory, which our own courts inclined to follow, was not surrendered until the English Naturalization Act was passed in 1870.

The *practical need* for impressment lay of course in the demand for seamen, the unpopularity of the English naval service, and the tendency to escape from it by shipping on foreign, largely American, vessels. This was particularly true in time of war, and most of all during the tremendous struggle against Napoleon in which Britain was engaged. And while enforcing her genuine belligerent rights against the neutral, it was easy and tempting to class search for impressment purposes amongst them. She pretended to limit it to time of war. In point of fact, however, the right was exercised against foreign vessels in time of peace as well. Diplomatic protest was made in 1792 against the practice; it had become a crying evil in 1794, when Jay's treaty was signed; it is believed to have been enforced likewise during the Peace of Amiens. And as it never was a *belligerent* right, it is fairly a part of our subject.

Now the impressment of seamen claimed as British subjects from American vessels involved the stopping and searching of some hundreds of such vessels under circumstances of the greatest exasperation and sometimes of loss. The Yankee skipper, perhaps already short-handed, saw his crew mustered by some arrogant young officer of a country which he liked none too well, and half a dozen of his smartest men dragged into the English service, their British nationality being assumed on the slightest evidence, and thus frequently mistaken. These suffering seamen, the captains and the shipowners, united for years in unavailing complaints. In 1803 an agreement to abolish the claim was nearly reached. It failed because England insisted upon retaining it in the narrow seas. And some years later came the proposal that the practice should be allowed by the United States, but subject to damages for any mistake as to nationality. This, however, would have authorized the impressment of foreign seamen from our ships and did not meet our real objections.

In truth, the right was never formally relinquished; it simply died out.

What was the flaw in the English theory and practice? It was not in the claim to unchangeable allegiance: that is a matter of state policy.

It was not in the claim to impress men for service on English men-of-war. That was a lawful measure which, though harsh

in its working, might well have seemed in that day essential to the safety of the state. It was a naval draft law, irregularly and violently applied. No! The real difficulty in the English theory was, that it was a claim to apply a municipal law outside of English jurisdiction; that it was a violation of the sovereignty of a friendly state. The search of a foreign ship, on the high seas, to enforce, not a belligerent right but a municipal ordinance, had absolutely no foundation except the right of the strongest. And so in time it lapsed, but not without leaving a trail of animosity behind.

For the enforcement of their revenue laws, several states have claimed and exercised the right of search upon the high seas in time of peace, and this practice, if legitimate, would be a genuine exception to our rule. Thus statutes forbidding transhipment of cargoes within four leagues of the coast have been in force from the last century both in England, under the name of the Hovering Acts, and in the United States of America, and according to Wheaton, "have been declared by judicial authority in each country to be consistent with the law and usage of nations." Portugal and Spain have asserted similar rights, but only to find that England was less ready to concede than to make such claims. The fact is that such statutes are good only when acquiesced in by foreign states, in accordance with the comity of nations. For they are only municipal, not international laws. They assert for a special purpose jurisdiction beyond the three miles of coast sea which is commonly conceded to be the limit of a state's territorial waters. Even if the extent of coast sea jurisdiction has been enlarged by the larger range of modern cannon, which is not the theory of our own Government, no such width as four leagues has been claimed for it. These Hovering Acts are really then, so far as legal authority goes, no better founded than the impressment claim. If the United States, for enforcement of revenue or health laws, boards a foreign ship four leagues out from New York and seizes her on suspicion, the said seizure may be complained of by her own Government, and we can point to nothing but many years of acquiescence in justification. In this opinion, I believe, modern publicists are pretty well agreed.

Twiss states his opinion thus: "A state exercises in matters of trade for the protection of her maritime revenue, and in mat-

ters of health for the protection of the live
permissive jurisdiction, the extent of which do
limited within any marked boundaries, furthe
not be exercised within the jurisdictional w
state, and that it can only be exercised over h
over such foreign vessels as are bound to he
that if these regulations "should be such as
unnecessarily foreign commerce, foreign nati
exercise." *

Lawrence, the latest English writer on the
Twiss approvingly, and also Dana, the best
Wheaton, to the effect that "the right to ma
the three-mile limit (and this involves a p
has no existence in modern international law.
"It is very doubtful whether the claim wo
against a remonstrance from another power.
submitted to, the submission is an act of cou

Although the law of 1799 still stands upon
it is doubtful if the attempt to enforce it wo
while the British Hovering Act was repeale
Consolidation Act of 1876, Sec. 134. We h
the last of this curious extension of revenue j

Akin to this right of search for revenue pu
to capture outside of the territorial waters of a
of revenue laws committed inside, after hot
theory is that a distinct offense against the st
mitted, and that the application of the pena
limited because in escaping the wrong-doe
three-mile limit and gained the high seas. E
right of search exists. For in the case of tl
(11 Wheaton, 42) the Supreme Court declar
"has never been supposed to draw after it an
or search. The party in such case seizes a
establishes the forfeiture he is justified."

I have sometimes wondered on what grou
pursuit of the Itata by the Charleston was or

* Sir Travers Twiss. The Law of Nations. In
edition, page 263.

† The Principles of International Law, p. 176.

trial it was interesting, and I believe satisfactory. But the only fault committed by the Chilian ship was a petty breach of the port regulations of San Diego, as the Government might have learned, while the pursuit was not hot, but began at San Francisco, four hundred miles away. The trial of the Itata, after her voluntary surrender by the Chilian Junta, showed that she was not fitted as a man-of-war, nor was she an armed expedition. The Chilian revolutionists had the same right to buy arms in the United States that the Cubans have now. Suppose a Cuban brig to enter at New Haven, act rather mysteriously, ship a cargo of Winchester rifles and cartridges, and make off without clearance papers. Then let the New York or the Columbia, lying in Boston harbor, be ordered in pursuit. The brig eludes her pursuer, reaches her port safely, but is surrendered with her cargo by the insurgents, who desire to stand well with our Government. This is a parallel case to that of the Itata. I think it has only to be stated to show the wrong-headedness of the Itata order.

The Bering Sea controversy is another instance of a claim to search and capture on the high seas, in enforcement of municipal, not international laws, which rightly, and fortunately, as it seems to me, has not been upheld. For it would have been unfortunate indeed if the United States, which has so consistently and manfully in the past stood for the freedom of the seas, should suddenly from interested motives try successfully to establish the opposite.

We approach now another topic, in connection with which the right of search in time of peace rests upon a surer basis—that of treaty agreement.

Early in the present century a remarkable agitation in England, led by men like Sir Fowell Buxton, Wilberforce, and Clarkson, forced upon the Government the policy of slave trade prevention. To accomplish this, the right of search was essential. This right, with seizure in case of guilt, was secured by a series of treaties between Great Britain and Spain, Portugal, the Netherlands, Sweden, and finally France, each of these states making the slave trade a criminal act by law. Now, since several of these treaty powers had no efficient cruising navy, the responsibility of making these laws effective was assumed by the British Government, though of course the treaties were

reciprocal in terms. In one or two cases a considerable sum was paid to secure this treaty concession of search; in fact the action of England, which has been followed even down to the present day, is a remarkable, perhaps unique, instance of national altruism.

But to put down the slave trade, the concession of search was needed from every important maritime state, for otherwise every slaver would hoist that state's flag. The United States, even earlier than England, had forbidden its citizens to engage in the slave trade, but when asked to arrange a mutual right of search with Great Britain, the memories of impressment were too unpleasant, and of British search too distasteful. Thus it happened that many slavers with an American register, or at least flying the United States flag, traded between the African coast and the ever lessening negro markets. We must remember, in this connection, that the abolition of the slave trade long preceded, here as in most other countries, the abolition of slavery.

This American slave trade was in violation of various statutes and of the national policy. Two curious decisions by English admiralty judges took advantage of this fact. One was rendered in the case of the Amedie (1 Acton, 240), an American ship trading in slaves between Africa and Cuba in 1810. She was taken, tried and condemned on the ground that under the English statute of 1808, and because of that statute, the slave trade was *primâ facie* illegal, but that it was open to a shipowner engaged in this traffic to show that by the laws of his own country it was permitted, which would work his acquittal. In conformity with this theory, a Swedish slaver, the Diana (1 Dodson, 95), was released because Sweden had not then prohibited such trading. By the condemnation of another American ship, the Fortuna (1 Dodson, 81), Lord Stowell added his great authority to that of Sir William Grant, in favor of this amazing judgment. It is amazing because it consisted in the claim of a right to enforce the municipal law of another state upon the ships of that state by foreign capture and foreign judicial procedure. Such a decision could not stand. It was overruled in Le Louis (2 Dodson, 210) a few years later, by Lord Stowell himself. This judgment is thus summarized by Mr. Pitt Cobbett in his "Leading Cases," page 77: "Neither any

British act of Parliament, nor any commission founded on it, could affect any right or interest of foreigners, unless it was founded upon principles and imposed regulations consistent with the law of nations. The first matter of inquiry was whether there was any right to visit and search. If there was no such right, and if it was only in the course of an illegal exercise of this right that it was ascertained that Le Louis was a French ship trading in slaves, then this fact having been made known to the captor by his own unwarranted acts, he could not avail himself of discoveries so produced. At present no nation could exercise a right of visitation and search upon the common and unappropriated parts of the sea, save only on the belligerent claim. The right of visit in this case could only be legalized upon the ground that the captured vessel was to be regarded legally as a pirate. But slave trade was not piracy in legal consideration, not was it a crime by the universal law of nations. A nation had a right to enforce its own navigation laws so far as it did not interfere with the rights of others, but it had no right in consequence to visit and search all *apparent* vessels of other countries on the high seas in order to institute an inquiry whether they were not its own vessels, violating its own laws." This was ten years and more before the French treaty granting search reciprocally. A similar mistaken reasoning, to be followed by a similar return of reason, took place in our own country, the Supreme Court in the Antelope (10 Wheat. 66) declaring that it was not the practice of the courts of any country to execute the penal laws of another.

This attempt to secure the right of search by judicial interpretation thus broke down, but the problem of slave trade prevention remained, and two attempts were made to solve it by treaty agreement. It was not until 1842, however, that this policy resulted in anything. It took the form of an agreement with Great Britain to maintain separate squadrons of eighty guns each on the African coast, to act in concert so far as possible. This still excluded a mutual right of search, and this omission was the cause of ineffectiveness. For unless ships of both countries cruised together, a vessel with American papers could escape British search and capture, in spite of the strongest suspicion, while damages were due for the detention of a lawful trader.

It was just before this treaty that the British Government propounded a new theory—the right of visit as disconnected with the right of search. Now really this claim to visit a ship for the purpose of inspecting her nationality—(to see if she might not belong to a state with which the treaty right of search subsisted, using a false flag for concealment)—though expressly denying it to be so, was simply the belligerent right of search in disguise. It was stated by Lord Aberdeen thus: "The sole purpose of the British cruisers is to ascertain whether the vessels they meet with are American or not. The right asserted has in truth no resemblance to the right of search, either in principle or in practice. It is simply a right to satisfy the party who has a legitimate interest in knowing the truth, that the vessel actually is what her colors announce. This right we concede as freely as we exercise. The British cruisers are not instructed to detain American vessels under any circumstances whatever, on the contrary they are ordered to abstain from all interference with them, be they slavers or otherwise. But when reasonable suspicion exists that the American flag has been abused for the purpose of covering the vessel of another nation, it would scarcely appear credible . . . that the Government of the United States, which has stigmatized and abolished the trade itself, should object to the adoption of such means as are indispensably necessary for ascertaining the truth." The same claim was asserted by others even more forcibly, but with the promise of damages in case of mistake and loss from its exercise.

Mr. Webster, in combating Lord Aberdeen's view, denied "any broad and generic difference between what has been usually called visit and what has usually been called search," asserting "that the right to visit, to be effectual, must come in the end to include search, and thus to exercise in peace an authority which the law of nations only allows in time of war. If such well-known distinction exists, where are the proofs of it? What writers of authority on public law, what adjudications in courts of admiralty, what public treaties recognize it?" And he goes on to assert that by publicists of all nations, by judges in their courts, and by statesmen in their diplomacy, the words visit and search have been used hitherto in the same sense.

To a practical mind it seems to me clear, that even if per-

mitted, the right to gather surface evidence of nationality would be valueless. The guilty would be provided with means of deception, and only the innocent would suffer. Quite apart from this, however, the contention of the United States was sound, that without precedents and in default of treaty, no right of jurisdiction, even the smallest, over a vessel apparently American, could possibly be recognized as belonging to Great Britain.

In spite of this discussion and these protests, in spite of the treaty of 1842 providing for separate action against the slave trade, the English navy was still instructed to use police surveillance over ships carrying the American flag, and to ascertain their nationality upon suspicion, but paying damages in cases of mistake. The diligence of Her Majesty's officers is thought to have been stimulated by the prize money involved, and their operations were transferred from the African coast to Cuban waters and the Gulf of Mexico. There many vessels were visited and some were captured; then our Government saw that it was time for an ultimatum. The Senate declared that any visitation, molestation, or detention by force, of the merchant ships of the United States was in derogation of its sovereignty; our diplomatists forcibly pressed this action and the arguments for it upon the notice of the British Government, and at last the latter yielded. The Earl of Malmesbury announced in the House of Lords, July 25, 1859, that acting upon the unanimous opinion of the law officers of the Crown, Her Majesty's Government frankly confessed that it had no legal claim to the rights of visit and of search which had been assumed, and therefore abandoned both. To the complaint that the Government was giving up a most valuable right, Lord Lyndhurst replied: "We have surrendered no right at all; for in point of fact no such right as that contended for has ever existed. We have, my Lords, abandoned that assumption of right, and in doing so I think that we have acted justly, prudently and wisely."

Throughout this whole discussion we must not for a moment think that the Government of the United States was disposed to sustain the slave trade. Its object and its duty were to oppose the unfounded British theories of search in time of peace. When these claims have been frankly given up as a matter of right, the mutual right of search could be safely conceded under treaty, and this was done in 1862.

Under this treaty of 1862, twice modified, the two countries are still acting. The right of search is granted only to vessels of war expressly authorized, thus denying it to the ordinary cruiser not on prevention of the slave trade service. It applies to merchantmen only, and in certain waters, namely, within two hundred miles of the coast of Africa south of the thirty-second degree of north latitude, and within thirty leagues of Cuba, Porto Rico, San Domingo, and Madagascar. Its method of application is carefully laid down to insure courteous treatment and prevent abuse, and damages for loss by illegal detention shall be borne by the respective governments. Mixed courts were set up to try slave-trading cases, but in 1870 these were abolished. The evidences of character, such as extra water casks or mess tubs, shackles, grated hatches, an unusual quantity of rice or other food with boiler for cooking it, and so on, were specified. And finally the treaty was made terminable after 1872, at a year's notice. Thus search as a right, asserted for seventy years by Great Britain for one purpose or another, gradually whittled down into visitation, then yielded altogether, became search under treaty. It is one more proof of our dictum that the right of search in time of peace does not exist.

Search on Suspicion of Piracy.

At one period of the slave-trade agitation (1824) the United States proposed to unite with a number of other powers in making that inhuman traffic piracy by statute and treaty. By this was meant only that slave-trading, as between the signatories, should be punished like piracy. Statutory piracy like this is under the ban of that state only which legislates against it. But the genuine article, piracy *jure gentium*, is quite another thing. It has two important characteristics. The first is that being committed upon the high seas, or by descent upon unoccupied land from the high seas, it is a crime which is not within the jurisdiction of any one state. The second is that it is not aimed at any one state, like privateering, but its *animus furandi* is general, it is war upon civilized society. It follows that all states have laid upon them the duty of suppressing piracy, and the courts of any nation have jurisdiction over it. In other words, it is part of the duty of every ship of war to search for and arrest pirates, while any admiralty court is competent to pass upon their character. This

is sufficiently familiar ground. But to us here there comes the practical question how this duty shall be exercised. It is inaccurate to call such right of search a belligerent right, because piracy is war upon human society. There is no more war than there is between a gang of ruffians in Oklahoma and the United States. It is simply a detail of naval police duty, in which you suspect a ship from her history or her appearance, and search or perhaps seize her in order to make her character clear. But suppose you make a mistake. By your action freight goes unearned, wages are wasted, a voyage is lost. Who stands the damage? And, moreover, what does search mean, when is it justifiable, how can you lawfully find out the character of a ship which appears to you in doubt?

Here we come upon the American doctrine of the right of approach. The English theory of visitation meant stopping a merchantman, inspecting her papers, ascertaining her real nationality and character by means which fell little short of search. The American theory of approach involved only closing in upon a ship for a nearer look, she meanwhile pursuing her voyage. It seems to have been first definitely laid down by the court in the noted case of the Marianna Flora (11 Wheaton, 40). It was in November, 1821, that the United States armed schooner Alligator, cruising against pirates and slavers, fell in with a strange sail. Their courses crossed, and the ships were separating, when the stranger shortened sail and slightly lowered a vane or flag—not a national flag—on her mast. These acts Lieutenant Stockton interpreted to be signals of distress, and approached accordingly. As he came up he was fired upon, and an encounter took place which ended in the surrender of the Portuguese trader Marianna Flora.

Stockton made no careful examination, but sent his prize in on the charge of piratical attack. Her story was that she mistook the Alligator for a pirate and acted in self-defense. The lower court acquitted the ship and awarded damages against Stockton. Appeal was taken to the Supreme Court on this question of damages, a matter of close upon twenty thousand dollars. In behalf of the claim it was urged that Lieutenant Stockton's approach, as well as the subsequent seizure, was unjustifiable; that the mere fact of approach authorized the attack. This claim, said Mr. Justice Story in giving the opinion, the court feels itself bound

to deny. It was argued again that the Alligator was bound to lie out of cannon-shot in making visitation and search. The answer was that this was no visitation and search, but an approach induced by the supposed signals of distress and other reasons.

"As we understand the general and settled rules of public law," said the court, "in respect of ships sailing under the authority of their government to arrest 'pirates and other offenders,' there is no reason why they may not approach any vessels descried at sea for the purpose of ascertaining their real characters. Such a right of approach seems indispensable for the fair and discreet exercise of their authority; and the use of it cannot be justly deemed indicative of any design to insult or injure those they approach or to impede them in their lawful commerce. On the other hand it is clear that no ship is, under such circumstances, bound to lie by, or wait the approach of any other ship."

And accordingly the decision of the lower court was reversed and damages refused. The Alligator had acted honestly though mistakenly, and there was enough ground for suspicion to warrant the capture.

In 1843 Mr. Webster quoted this opinion as expressing his view of the means which a vessel of war may use in peace to ascertain the character of any other ship on the high seas.

President Tyler, in a message to Congress the same year, incidentally lays down the same rule. "To seize and detain a ship upon suspicion of piracy with probable cause and in good faith, affords no just ground either for complaint on the part of the nation whose flag she bears, or claim of indemnity on the part of the owner. The universal law sanctions and the common good requires the existence of such a rule. The right under such circumstances, not only to visit and detain, but to search a ship, is a perfect right and involves neither responsibility nor indemnity." Do not overlook his phrase "upon suspicion of piracy with probable cause," for it conditions the whole statement.

With these opinions, judicial and official, the text-writers seem to agree.

Chancellor Kent concedes the right of approach (as described by the United States Supreme Court in the Marianna Flora) for the sole purpose of finding out the real character of a vessel under suspicion. (Kent's Com. I, 153.)

Ortolan, the French publicist, himself an officer in the navy,

distinguishes inquiry into the nationality of a ship from a search of her. Upon legitimate suspicion of piracy, however, you may search, but subject to the payment of damages by your government. (Ortolan, Dipl. de la Mer, III, 7, p. 258, 4th ed.)

The English writer Lawrence, publishing in 1895, when speaking of prize court procedure, says: "If the grounds on which the capture was effected turn out to be good, condemnation will ensue and the captors will receive the proceeds of the sale of the captured property in the form of prize money. If the evidence against the vessel is not conclusive in spite of circumstances of just and reasonable suspicion, she will be released, but her owners will have to bear the expense of detention and delay. But if the capture was effected on foolish and frivolous grounds, the officer responsible for it will be condemned in costs and damages. And the same rule holds good in the more difficult matter of the treatment of vessels suspected of piracy by the cruisers of non-belligerent powers. Being at peace, they have no right to search unless the ship they have in view is really a pirate, in which case they are free to go further and capture. But they cannot tell whether the right to seize the vessel exists until they have visited and overhauled her. They must, therefore, be guided by surrounding circumstances. Should the information they have received and the behavior of the vessel when approached give rise to a reasonable suspicion that she is a pirate, their commanders are not liable for damages for seizing her, even if it should turn out that her errand was perfectly lawful. But if they have made an inexcusable mistake they must suffer for it. On the other hand, should the vessel be really a pirate, their action is lawful from the beginning, and they have performed a meritorious service." (Lawrence, Int. Law, p. 395.)

Here, then, we have the rule clearly stated. Yet the rule itself is not clear. It is part of a navy's duty to suppress piracy. A ship of war may lawfully take a close view of any vessel. Upon suspicion of piracy it may search and even seize that vessel. If the suspicion turns out to be well founded, the search and arrest were meritorious acts. But if the search shows no fair ground for suspicion, then damages are due. To determine whether a suspicion *was* justified or not is easy for a court with means of securing evidence at its command. To determine from an outside view whether search is *likely* to be justified, is not so easy for

the naval officer who between duty and damage is between the devil and the deep sea.

We must hope that the new photography will be equal to this dilemma, and that a search-light may be discovered of such power and quality as to give us a shadowgraph of the ship's interior, the captain's intentions and the hearts of the crew.

One more inquiry, gentlemen, and my topic will be threadbare. May there not be a right of search on the high seas in time of peace, founded upon and justified by the right of national defense? Self-defense has been called the first law of nations as of individuals. It has sometimes been held to justify very gross violations of the jurisdiction of one state by another, as in the case of the Caroline. Have we not here a genuine exception to our general rule? A case which brought up this question among others is that of the Virginius. It was in 1873 during the first Cuban insurrection, to which no belligerent rights were accorded by this country. The Virginius had an American register and flew our flag. For nearly three years she had been employed by Cuban sympathizers in delivering men and arms from various points. Late in October, 1873, at Kingston, Jamaica, she took on a body of drilled Cubans, nearly one hundred in number, who had come down by steamer from New York. To these were added certain Cuban leaders and eighty men who had been picked up separately. She sailed for San Domingo, was warned away, and then went to Port-au-Prince, in Hayti, where she loaded a quantity of arms and ammunition. She made a further stop at Corinto, shipping additional military supplies, with shoes and clothing. Thus assembling an organized body of men and material of war for their use, she was clearly engaged in transporting a military expedition and not mere contraband articles. From Corinto crossing to Cuba she cruised eastward along the coast seeking a landing. Off Point Guantonomo, six miles from shore, the Spanish cruiser Tornado came in sight. All the Spanish men-of-war had been warned to look out for and capture the Virginius; that is, her character and business were notorious. She ran out to sea towards Jamaica, but finding herself overhauled, threw the military portion of her cargo overboard and then surrendered, relying upon her American flag and register. At Santiago de Cuba, where she was taken, her passengers and crew were summarily tried by court-martial. Four were shot on

the fourth of November, thirty-seven on the seventh, sixteen on the eighth; of those executed, nine were Americans and sixteen British subjects. There were over one hundred left, but further executions were stopped by the remonstrances of the British officials.

The effect of the news of this affair in the United States was tremendous. A cry of rage and warlike desire went up, the like of which was not heard again until 1891, apropos of the attack by a Valparaiso mob upon the seamen of the Baltimore.

Although aware that a doubt existed as to the real ownership and nationality of the Virginius, Secretary Fish completely disregarded this and through General Sickles, our minister at Madrid, demanded the surrender of the survivors, the restoration of the ship, and a salute to the United States flag, under threat of breaking off diplomatic relations in twelve days. To this the Spanish Government yielded, with the single proviso that if the ship proved to have gotten her American register fraudulently, as turned out to be the case, the salute should be dispensed with.

Now there are several interesting questions involved in this Virginius case, and perhaps it is simpler to reach that particular inquiry which relates to the right of search by process of exclusion.

Let us set apart then entirely the summary execution of two-fifths of the crew as an act barbarous, unjustifiable and directly in violation of treaty. They were taken with no arms in their hands; they were shot, not in self-defense, but in revenge; they were in no sense pirates *jure gentium*; they were tried by drum-head court-martial, whereas Art. VIII of the treaty with Spain of 1795 distinctly provides that "in all cases of seizure, detention or arrest for . . . . offenses committed by any citizen or subject of the one party within the jurisdiction of the other, the same shall be made and prosecuted by order and authority of law only, and according to the regular course of proceeding usual in such cases," with full right to employ counsel. This same treaty provision has been successfully invoked within a few months to protect the few Americans captured on the filibustering ship Competitor from similar execution as the sequence of a similar trial.

When Americans are captured fighting against Spain, with arms in their hands, they must be held to have entirely identified

themselves with the insurgent cause and to have lost the right to protection which their nationality would give them. Under other circumstances a fair trial, under the treaty, cannot be refused them. But however indignant we may be at this instance of Spanish inhumanity, we must not allow our calm estimate of Spanish rights to be prejudiced thereby.

The next inquiry turns on the nationality of the ship. The investigation of the Attorney-General brought out these facts: The Virginius had been granted an American register on the oath of an American citizen that he was her owner. The law requires in addition a bond signed by the owner and captain with sureties, but no sureties were furnished. It appeared also that the real owners were certain Cuban sympathizers who furnished the purchase money and had controlled the ship's movements for nearly three years.

On these two grounds of defective bond and foreign ownership, the ship was declared to have no American nationality. If not an American ship, what ship was she? Clearly she belonged to that state to which her real owners belonged, that is, to Spain. Mr. R. H. Dana, the learned editor of Wheaton, is explicit on this point, writing in a Boston paper of January 6th, 1874, that actual ownership by a person belonging to a state places a ship on the high seas under the jurisdiction of that state, and applying this law to the Virginius. Over a Spanish ship on the high seas the Spanish Government had complete jurisdiction to search, to seize, to condemn her according to its own laws.

And conversely over a Spanish Virginius our own Government had no jurisdiction. For the surrender of the ship, for the release of the foreign portion of the crew, for the apology due our flag, it had no lawful claim. But of all this the administration seems to have been singularly heedless. For President Grant in his message to Congress of January 5th, 1874, declares that the Virginius would "appear to have had, as against all powers except the United States, the right to fly its flag." And again, "If her papers were irregular or fraudulent, the offense was one against the laws of the United States, justiciable only in their tribunals." And in the promise of surrender by Spain he finds recognition of the soundness of his position. He knows of the doubtful registry and ownership of the Virginius, yet completely ignores the consequences which would flow from proof of Spanish ownership.

His claim amounts to saying that a foreign ship which has fraudulently secured an American registry and fraudulently flies an American flag is thereby divested of foreign nationality and becomes an American vessel subject to the punishment of its owners for a violation of our laws.

The third point to which I ask your attention is akin to this, but bears directly upon our subject. After showing that the American register of the Virginius was fraudulent and that she had no right to fly the American flag, the Attorney-General added: "I am also of opinion that she was as much exempt from interference on the high seas by any other power on that ground as though she had been lawfully registered." This is equivalent to saying that, so far as Spain was concerned, the fact that the Virginius carried an American flag—whether fraudulently or not—was conclusive; that Spain lost its jurisdiction over its own ships if they could fraudulently show another flag and register. It is safe to say that we should never allow another state to assert such a monstrous doctrine against us. It was warmly attacked by some of the leading jurists in the country at the time, in spite of the popular outcry. Thus, Mr. Dana said: "The register of a foreign nation is not, and by the law of nations is not recognized as being a national voucher and guarantee of national character to all the world, and nations having cause to arrest a vessel would go behind such a document to ascertain the jurisdictional fact which gives character to the document, and not the document to the fact." Pitt Cobbett (Leading Cases Int. Law, p. 93) comments thus upon the question of the finality of the flag: "It is necessary to remember that had the Cuban insurgents been recognized as belligerents the public vessels of each combatant would have been entitled to exercise the right of visit and search in regard to neutral vessels on the high seas. In default of a recognized state of belligerency it can scarcely be maintained that even on the high seas the flag is final, and absolutely precludes a state engaged in suppressing an insurrection from molesting a vessel suspected of aiding rebels." And he goes on to say that upon suspicion that a ship is waging war against a state, or is really owned by its subjects, search is justifiable, but limited by the necessity of compensation in case of mistake.

And now to go one step farther.

It seems to me not unreasonable to assert that, even if the Virginius had been an American ship, entitled to her flag and with a register of unquestioned validity, Spain had nevertheless the right to search her and to seize her on the high seas, on the ground of self-defense. She and her like were feeding the insurrection with supplies and with men. They were dangerous, the Virginius notoriously so. Is not the right of self-protection under such circumstances paramount to every other right? It is noticeable that the English Government, though protesting against the hasty execution of her subjects on the Virginius, made no complaint of the seizure of the ship. It demanded their release, yet said at the same time, "Much may be excused in acts done under the expectation of instant damage in self-defense by a nation as well as by an individual. But after the capture of the Virginius and the detention of the crew was effected, no pretense of imminent necessity of self-defense could be alleged."*

And Hall adds (2nd ed., p. 252): "It is clear from this language that the mere capture of the vessel was an act which the British Government did not look upon as being improper, supposing an imminent necessity of self-defense to exist." Yet there were more British subjects executed than American, and Great Britain is thought to take uncommonly good care of her citizens' lives.

Similarly Mr. Geo. Ticknor Curtis, in an able discussion of the case in 1874, says: "It will be seen, therefore, that we rest the seizure of this vessel on the great right of self-defense, which, springing from the law of nature, is as thoroughly incorporated into the law of nations as any right can be. No state of belligerency is needful to bring the right of self-defense into operation. It exists at all times, in peace as well as in war. The only questions that can arise about it relate to the modes and places of its exercise." †

To quote one more authority, President Woolsey ‡ states the rules of International Law illustrated by the Virginius case as follows:

* Parl. Papers CXXVI, 76, 1874, 85.

† The case of the Virginius, pp. 36, 37, by Geo. T. Curtis, New York and London, 1874.

‡ Woolsey's International Law, 6th edition, page 370.

"1. The right of self-defense authorizes a nation to visit and capture a vessel, as well on the high seas as in its own waters, when there is reasonable ground to believe it to be engaged in a hostile expedition against the territory of such nation.

"2. A nation's right of jurisdiction on the high seas over vessels owned by its subjects, authorizes the detention and capture of a vessel found on the high seas which upon reasonable ground is believed to be owned by its subjects and to be engaged in violating its laws. The flag or register of another nation, if not properly belonging to a vessel, does not render its detention unlawful by the cruiser of a nation to which its owners belong."

From these opinions in opposition to that of the Attorney-General I do not find amongst the publicists who have discussed the affair a single dissenting voice, though one or two do not go quite so far or express themselves quite so clearly.

To me it becomes a clear case if we can imagine the tables turned. Let us suppose that in 1861 Mr. Seward had carried his point and had prevented the recognition of Southern belligerency by any foreign power.

Let us suppose a ship under British colors, but which almost certainly belongs to certain Confederates, to be engaged several times a year in landing men and arms at various points of the Southern coast.

There is no legal blockade because there is no legal war. You have been warned to look out for this ship. You find her attempting a landing. She runs away and you catch her. British ship or not, entitled to her flag or not, is there an officer in our navy, or an official of our government, who would not believe her to be lawfully captured in self-defense and applaud the captor?

But though we admit the right of search in peace on the ground of self-defense, there is still and always will be the practical difficulty of knowing when it is applicable. As in search on suspicion of piracy, there is a duty and there is a danger. We can be sure only in extreme cases. We must weigh every fact and act calmly. Here then is the one real and only exception to the rule that the right of search on the high seas in time of peace does not exist.

In one of Norris' stories, Thirlby Hall, the hero goes to the

village church and pictures for us the drowsy service and the quaint building. There was the old, square pew with its shabby hassocks; the well-remembered musty smell, for which partly damp and partly the remains of his decaying ancestors were responsible; and there was the village choir in the gallery bawling out " I will arise," to the accompaniment of various scriptural rather than musical instruments. And then there was the sermon. " This, like all the rector's discourses, was constructed upon time-honored and unvarying lines. Firstly, what was so-and-so? Was it this? No! Was it that? No! Was it something else altogether improbable? Again no! What then was it? Which led to the agreeable discovery that after all it was very much what the untutored mind would have pronounced it to be at first sight.

" Secondly, how was this doctrine illustrated by examples from holy writ? Examples from holy writ, more or less apposite, followed.

" Finally, brethren, how did this great truth come home to all of us? The unsatisfactory conclusion being that it ought to come home to us in many ways, but that by reason of the hardness of our hearts it didn't. Then there was a great shuffling of hob-nailed boots, a great sigh of relief, and we were dismissed."

I fear, gentlemen, that my lecture is constructed like the old rector's sermon.

The right of search in time of peace, does it exist to enforce impressment laws? No.

Does it exist for revenue purposes? Not as a right, and only by acquiescence.

Does it exist for putting down the slave trade? Only under treaty.

When then is it permissible? Only for suppression of piracy and self-defense, and then with full liability for blunders. And after reaching this very natural conclusion, I seem to hear that same sigh of relief which closed the old clergyman's exhortations.

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THE CHRONOLOGY AND GEOGRAPHICAL DISTRIBUTION OF ICEBERGS IN THE SOUTHERN AND ANTARCTIC OCEANS.

By W. T. Gray, M.S.

Icebergs in the northern oceans have received much attention at the hands of many intelligent writers, but comparatively little has been published in recent years concerning the ice in the southern and Antarctic oceans. It appears from what has been written on the subject that there are years of few or no icebergs, followed by a period of years of a great accession of bergs. Such a period of remarkable frequency of bergs is that of 1891-1895, and with this period, or rather the period from 1888 to 1895, the present essay and its accompanying charts especially deal.

It is not necessary to dwell upon the importance of the ice problem, or the risks and perils of the navigator in the southern oceans, due to the immense floating islands and also to the detached pieces of ice, which are in themselves sufficiently large to do serious damage to the staunchest vessels afloat.

If we could have the testimony of those brave and gallant navigators who have left port in noble ships, and who have neither returned nor left any traces as a basis for speculation as to their fate, we would probably, in many instances, learn of a sudden shock, of the rending, falling masses of ice, the rushing of water, and the quick engulfment of the vessel and crew. The collision with a gigantic iceberg occurs so suddenly and with such terrific force as to appal the bravest.

As in the northern hemisphere the origin of icebergs is in the polar regions, principally in Greenland, so in the southern hemi-

sphere their place of formation is in the Antarctic lands, concerning which we know only a "few discontinuous coast-lines." Reasoning as to their formation, by analogy, from our observations in Arctic regions, we may suppose them to be formed in a similar manner in the south polar regions; that is, from the large glaciers that are formed on sloping lands by the accumulation of falling snows and congealing rain and fog.

These glaciers, "of so imposing and magnificent an aspect, in spite of their apparent immobility, have a descending movement, slow and continuous," toward the sea, and "protruding their margin into the water until the stability of the mass and buoyancy become neutralized and the margin breaks off, or *calves*, as it is termed," and casts those huge masses of fresh-water ice adrift into the "great Antarctic drift current, so called in the Pacific, as well as in the Atlantic and Indian oceans."

"This great body of water moves toward the east between 40° and 60° south, with a constancy similar to that of the prevailing westerly winds. It is especially noticeable in the Pacific between 45° and 55° south, and from Tasmania and the south point of Stewart Island (New Zealand) to about 118° W., where a portion breaks off and forms the Menton current, which moves to the N.E., towards St. Ambrose Islands. The greater part, however, of the main current continues to the eastward, as far as about 85° west, where the southern branch divides into two currents between 42° and 47° south, one bearing to the northeast, forming the Chili current, and the other tends to the E.S.E. and S.E., toward the Gulf of Peñas and Straits of Magellan, and forms the Cape Horn current."

Borne away upon Antarctic currents, the icebergs drift into lower latitudes and melt in warmer water. The icebergs which leave the Antarctic continent at 63° or 65° S. "experience little change by the melting process until the 60th parallel is reached." It is commonly thought that they melt most rapidly under water, and "the change of center of mass and shifting of berg into new positions of equilibrium, undermining, fracture, etc., causes irregular and fantastical shapes." This change of center of mass and the exposure to view of new surfaces is probably often due to the loosening and letting go of huge rocks, boulders and stones imbedded in the berg, since "icebergs, like glaciers, are great transporting agents," bearing away to the deep sea these solid substances.

It is difficult to arrive at the average size of these bergs, as they are reported of all sizes, up to 800 or 1000 feet in height and up to several miles in length. The shapes of the bergs are also reported as being of almost every conceivable form, but in the southern oceans the bergs, as a rule, do not have so frequently the towering spires that are often a characteristic of those seen in the northern oceans, but are comparatively flat-topped.

The icy barriers have been reported to have the appearance of vast chalk cliffs, and "it is a question whether the discontinuous coast-lines constitute parts of a continent, or whether they are, like the coast of Greenland, portions of an archipelago, smothered under an overload of frozen snow which conceals their insularity." "It is calculated that the center of the polar ice-cap must be three miles deep, and may be twelve miles deep, and the material of this ice mountain being viscous, its base must spread out under the crushing pressure of the weight of its center." "This extrusive movement thus set up is supposed to thrust the ice cliffs off the land at the rate of a quarter of a mile per annum."

Mr. Findlay explains the difference in appearance of icebergs in northern and southern oceans as follows: "In the north they are formed on a limited space of land, chiefly Greenland, and here the land ice reaches the sea down narrow fiords in the form of glaciers, literally rivers of ice, whose outflow into the sea is constantly disrupted, and in the spring the masses drift southward in every variety of size and figure except the tabular. In the south, on the contrary, the whole of the south pole appears to be encircled with land covered with this tremendous icy mantle, without any inlet into its interior, as in the case of the Arctic regions, unless there should be such south of Cape Horn, and thus there is no influx of warm water which can penetrate into the rear of the icy barrier (as is the case in Baffin's Bay and around Spitzbergen) to dissolve and drift it out in a similar way."

The motion of an iceberg is a compromise motion of wind, surface current and undercurrent. The southerly gales in the Antarctic region, due to the cold air caused by the presence of glacial formations settling down and squashing out, is probably the greatest factor in causing a strong surface current, which has much to do with the northern movement of the berg.

Drifting to lower latitudes through the effects of currents and winds, "as the distance from their birthplace increases, they are

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is given from the report received at the I
from Captain A. John Miller, British bark L:
Portland, Oregon, to Galway: " February 8,
in latitude 50° 50′ S., longitude 48° 17′ W.,
berg about a point on the port bow; from
yard we could see several others ahead and oı
at 8 P. M. we were up to the front one aı
number of others. We were favored with
and a steady breeze from W.S.W. to W.N.
knots an hour, steering N.N.E.; during the
day we were passing through between these
we could see on both sides as far as the eye (
them over a mile long, and ranging from
height. From 1 P. M. to 4 P. M. (three l
large bergs, besides numbers of small ones.
of them we heard them crack and saw piec
the noise being like the report of artillery f
close to leeward of the large bergs there was
ice, large enough to be very dangerous to s
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gust of wind off of them, just like squalls c
enough to make us lower our royals someti
the evening of the 9th of February we passe
berg, having been just 24 hours among ther
about 180 miles through them in a northea:
5.30 next morning we passed three small pi
none during the night, nor have we seen any
ing through this vast field of ice there was n
in temperature of either air or water, the th
air 46° F., water 44° F. It was a grand sigl
rise, and one never to be forgotten by those

As to size of icebergs sighted in the southern oceans, Chief Officer Cummings, of British bark Beechwood, reports to the Hydrographic Office that "on the 6th of December, 1893, they met with a number of icebergs in lat. 40° 43′ S., long. 42° 28′ W. Through these navigation was extremely difficult. Great precaution was taken at night, sail was shortened during the night, an incessant lookout kept to prevent collision with any of these frightful obstructions to clear sailing. On December 7th, lat. 47° 7′ S., long. 41° 44′ W., other bergs were encountered, necessitating renewed vigilance. On the same day a monster berg hove in sight. It was a mighty mountain of ice, moving slowly in solitary grandeur among the great Atlantic waste." Captain Mansus, master of the Beechwood, and Mr. Cummings, chief officer, estimated the length of this appalling mass of ice to be 15 to 20 miles, and its height 300 to 400 feet. The captain of the Drumcraig also reports to the Hydrographic Office that "on December 29th, 1892, in lat. 49° 34′ S., long. 45° 53′ W., he sighted a large ice island fully 300 feet high and 25 or 30 miles long." These dimensions are wonderful, but not of more than half the horizontal dimensions of the body of ice which Mr. Towson tells "was passed by 21 ships during the five months of December, 1854, and January, February, March and April, 1855, floating from lat. 44° S., long. 28° W., to lat. 40° S., long. 20° W., with a height not exceeding 300 feet, but of horizontal dimensions of 60 by 40 miles. It was reported to be of the form of a hook, the longer shank of which was 60 miles, the shorter 40 miles, and embayed between these mountains of ice was a space of water 40 miles across." When we consider that only about one-ninth of the mass of an iceberg is above water we wonder at their magnitude and source, and yet we can more readily imagine their source when we recall the fact that "Sir James Ross followed the line of the enormous ice cliffs in the Antarctic regions for 450 miles and more, which had an unvarying height and character, calculated to be upwards of 1000 feet in thickness." Similarly, Capt. Wilkes "in some places sailed for more than 50 miles together along a straight and perpendicular wall of ice from 150 to 200 feet in height."

Among the Hydrographic Office files is an interesting report from Captain Doan, of the American ship Francis, which I give in full:

"February 16, 1893, at noon, lat. 51° 01′ S., 49° 15′ W., we passed between two large icebergs, about 15 miles apart, and saw to the S.S.E. of us another *very* large berg several hundred feet high and a mile or more in length. Put the ship under easy sail for the night. At 1 A. M., 2.30 A. M. and 4 A. M. passed large bergs. Weather cloudy and misty. Wind hauling to N.W. Soon after 4 A. M. it began to get daylight, when we saw before us an immense barrier of ice, extending from N.W. to S.E., as far as we could see from aloft. Some of the floating glaciers were miles in length and from three to five hundred feet high. Stood to within a mile of the track, but seeing no safe passage through the barrier, we wore ship to southwestward at 5 A. M. We now saw icebergs all about us. Temperature of air and water from 47° to 50°. At noon wore ship to northward, passing a number of large and small bergs. At 3 P. M. saw the barrier again, to leeward, still continuing its line from N.W. to S.E. and as impenetrable as before. Stood on till 5.30 P. M., and as the ice was visible to N.W. (2 points off weather bow), as far as we could see from aloft, we again put the ship on the southern tack. Wind hauling to S.W. and steadily increasing to a moderate gale. Now having the ice fields for a lee shore was anything but pleasant to contemplate during the long night watches. February 18th, midnight, wore ship to W.N.W. Reefed upper foretopsail, furled upper mizzen. Rough sea. At daylight we saw a berg ahead about one mile long and three or four hundred feet high. It was perfectly level on top, and its sides and ends were as perpendicular and clean cut as the blocks of ice taken from our lakes and rivers at home. It is also apparent that these immense pieces of ice are in the same condition as when first broken from the main glacier, as the irregular angles of the smaller bergs indicated that they had turned over occasionally. At 11 A. M. saw the dreaded barrier again, still extending to N.W. At noon our position was lat. 50° 29′ S., long. 47° 12′ W. Found we had a very strong N.E. current setting us towards the ice, adding another factor to the manifold dangers by which we were surrounded.

"At 1 P. M. judged we could see the end of the barrier to the N.W., or about 1½ points off our bow. Gave the good ship all the sail she could bear and pushed her through a very large and turbulent sea, caused partly by the deflection of the strong

N.E. current against the large mass of ice under water (the pack being from two to four miles to leeward).

"We now had the satisfaction of seeing the ship steadily draw past the last fearful piece of this gigantic ice field, which we found by careful measurement by the patent log was just six miles long and, as near as we could judge, it was three or four miles wide. This would give an unbroken area of 18 or 20 square miles, between three and four hundred feet *above* the sea. (At 4.15 P. M. passed the N.W. point of ice, lat. 50° 13′ S., long. 47° 23′ W. Saw the ice extending away to N.E., but no more in our vicinity.)

"Too much notice cannot be given to our mercantile marine of this great danger that lies directly in the fair way of vessels bound eastward around Cape Horn, as it will doubtless take years before such a mountain of ice (such as I have described) to be destroyed, and that was only one of many more that *we saw* in this ice field, extending from lat. 50° 13′ to 51° S., long. 46° 45′ to 47° 23′ W., and how much beyond I am willing to leave to some other navigator to tell."

Referring again to indications of approach to ice, many ways have been suggested; especial reliance upon the thermometer is often advised, but while in many instances this would no doubt prove useful, yet we have some reports showing that the thermometer cannot always be relied upon to indicate the proximity of ice. Besides the report previously referred to, we also have the following from Captain McMillan, of the British ship Dudhope: "Careful thermometric observations of air and water were regularly taken, but our approach to ice, always from windward, was not once indicated by any appreciable change of temperature in either air or water. On passing to leeward of the bergs a fall of a few degrees was generally observed *in the air*. On one occasion we passed within a cable's length of a berg and found the temperature to be the same there as at several miles distance. This would go to show that in thick weather, or in any other, even temperature and thermometer at normal height should not be accepted as a reliable guarantee of immunity from ice. Care and a most vigilant outlook are the only reliable safeguards. To depend on the thermometer would mean disaster, as I am convinced that a ship would be too close to the ice to extricate herself by the time the thermometer would indicate its presence."

As has already been stated, there are years of very few or no icebergs, and then years when great numbers are reported. In the year 1832 the southern ocean was so covered with icebergs that a number of whaling vessels, bound round Cape Horn, encountering them, put back to Valparaiso to await a more favorable season, because it appeared too dangerous to undertake the voyage. Again in 1854 there was a great accumulation of icebergs, and now during the past few years, notably 1892 and 1893, there has been another notable output from the great berg factories of the Antarctic regions. During the intervals between these periods there have been very few bergs reported. What causes this occasional great accession of bergs? Some authorities offer as a probable explanation the breaking off of the ice margin by volcanic eruptions, and others that earthquakes cause numerous pieces of the glacier to become detached and set adrift as icebergs, and others that unusual heavy annual snowfall is favorable for increase in number of bergs. The rapidity of glacier movement seems usually to regulate the number of bergs cast off. If the ice at the bottom of the glacier moves so slow that the melting of the margin on coming in contact with the salt water equals the advance, then we would have no icebergs, except perhaps those breaking off from the upper part of the outer margin, and these would be comparatively small.

In order to obtain facts for study, charts have been compiled from reports deposited in the Hydrographic Office, Department of the Navy. Through the courtesy of Commander C. D. Sigsbee, Hydrographer, I was permitted to use the files of the office. Out of several thousand meteorological reports examined, 307 reports of ice in the southern oceans were found, and upon these the charts are based. For the years 1892, 1893, 1894, and 1895 a large number of reports was found, especially in 1893 and 1895; while in the other years, notably 1888, only one or two reports of icebergs sighted were found, although about the same number of reports of vessels going over approximately the same route was carefully examined. The conclusion from this is that during the years 1888, 1889 and 1890 there were comparatively few icebergs in the southern oceans.

There are two charts, one representing the seasonal iceberg limits, together with approximate sailing routes to various points, and the other showing by different colors the icebergs

reported in the different seasons throughout the period under discussion. It must be understood that the routes do not by any means represent the various routes taken by vessels whose course is determined by the direction of the wind. On the seasonal chart the icebergs plotted in red are those sighted in June, July and August; in blue, for September, October and November; in green, for December, January and February; in yellow, for March, April and May.

The charts deal entirely with icebergs and not with other forms of ice, such as field ice or ice floes. They give a graphic presentation of reports of icebergs seen during the different seasons, and convey a general idea of the number and positions of icebergs. The chart of limits may serve as a "practical guide to mariners as a warning in approaching the regions where especial vigilance is essentially required." On the chart of icebergs the positions of bergs are plotted as nearly as practicable as reported, and when too numerous to plot, the number is given, or, if no number, but "numerous," or "large number of bergs," is reported; the letter "L" is placed by the side of a berg in the color corresponding to the color used for that season. In a few instances, where bergs are reported as "fast breaking up" or "rotten-looking," a note is made on the chart.

From plotting upon the chart the icebergs reported in the months of December, January and February during the years from 1891-1895, distinguishing by symbols the bergs seen in different years, it has been found that the greatest number was reported in 1893 and 1895, with a smaller number in 1892 and 1894, and the smallest number in 1891. We find groups of bergs south of Cape Horn, east and northeast of the Falkland Islands, and south of Africa, and a line of bergs stretching to the eastward near the 45th parallel, with the most easterly one, in January, 1892, on the 75th meridian east, while to the west of Cape Horn, in 1892, we find a line of bergs extending along near the 55th parallel from 100° W. to 135° W. The greatest frequency is in December and January, and the lowest latitude reached is in December and January, 1893 and 1895.

From a similar chart for March, April and May, the months of March and April, 1893, have the greatest number, with no reports for 1888, 1889 or 1894. The principal group is east and northeast of Falkland Islands, and is entirely for the years

1893 and 1894, while the group for 1895, south of the Horn, has become much smaller. The most easterly report is in 32° 30′ E. and 42° 30′ N., and the most westerly one is near the 50th parallel and 135th meridian west.

On a chart for the southern winter season, June, July and August, we find all the years under discussion represented except 1888 and 1889, with the greatest number in 1892. There is a group immediately south and near Cape Horn, and another large group between 40° S. and 45° S. and 30° W. and 40° W., and still another large group between 40° S. and 45° S. and 25° E. and 30° E. There is also a line of bergs reported in July, 1895, extending from 44° E. to 67° E., near the 45th parallel. There is a small group reported in the same month and year near the 55th parallel and 160th meridian W. A large group of bergs was reported in July, 1892, in the remarkably low latitude of 37° S. and near 42° W.

On a chart for September, October and November we find a large group of bergs south of Cape Horn, and it is seen that this group is made up entirely of bergs sighted in 1895, with the exception of two bergs reported in November, 1891. East and northeast of the Falkland Islands we find all the years represented except 1891 and 1894, with only one report each for 1888, 1889 and 1890. Near the 40th parallel, and from 0° to 5° E., there is a large number reported in 1893 as "low, rotten-looking bergs, fast going to pieces." This is the only season in which we have any bergs sighted in 1888. The chart for this season is remarkable for the years represented, as well as the east and west limits. Bergs were reported in 1893 at 180° W., and in the unusually low latitude for that part of the ocean of 42° S., near which position 78 icebergs were reported. We also find a group in 1893 near the 45th parallel and 160th meridian E.

The accompanying "Chart of Ice Limits for the Four Seasons" shows the northern limits reached by the ice in the different seasons; the limit for December, January and February is shown in green; for March, April and May, in yellow; for June, July and August, in red; and for September, October and November in blue. The broken black lines indicate approximately the sailing routes to various points. The ice-limit lines are shown only where ice has been reported during the season

considered. From this chart it appears that the greatest northern limit reached in the South Atlantic for the period under discussion was in the season of June, July and August, reaching to about 37° S., near the 20th meridian W. This limit is nearer the equator than the usual summer limit of the northern ice, as we find by an inspection of the ice charts published on the North Atlantic Pilot Chart for June, 1894, covering a period of seven years, that the lowest southern limit is 40° N., and near the 50th meridian. A few bergs are shown in the chart of limits north of Falkland Islands, and are not enclosed within the limits shown. It is an unusual position for bergs, but the surface current near the islands shows that they might easily have been drifted to the position shown.

In July, 1895, a number of bergs were reported between the Cape of Good Hope and Australia, but none reported after that, except one berg in November near 45° S. and 50° E. This sudden disappearance of the bergs may have been caused by rapidly breaking up, but probably by having been driven by heavy winds causing a strong set of the current toward higher latitude and out of the track of vessels.

An inspection of the chart would seem to show that the bergs are formed at several different special parts of the Antarctic Continent, and are then, by the compromise force of wind, surface current and undercurrent, drifted northward, then northeasterly, and then easterly. If we should be fortunate enough to get reports for the years under discussion from higher latitudes it might be possible to trace back, from the group of bergs, to the Antarctic lands, and find the approximate place of formation of these groups.

The life of a berg in the southern oceans is probably much longer than that of one in the northern ocean, since they are larger and more compact, and as we have seen, drifts to lower latitudes in the South Atlantic than those in the North Atlantic. Mr. Towson states that "in January, 1850, an iceberg was within sight of the Cape" (Good Hope), "and that in April, 1828, and in August, September and October, 1840, there were several icebergs in this locality." This is an unusual position for bergs, being 34° S. The northern limits of icebergs for the years of which this paper treats reach farther north over the whole southern ocean generally than at any period for which similar

deductions have been found. Some of the bergs sighted in the South Atlantic during this period have been reported as being earth-stained and discolored. This may have been due to the iceberg "exposing the side of some old crevasse, into which débris from a surface moraine has fallen."

To show the remarkable drift of pieces of these southern icebergs, the following extract is taken from a report received at the Hydrographic Office from the master of the brig Dochra: "On April 30, 1894, latitude 26° 30′ S., longitude 25° 40′ W., at 10 A. M., observed a piece of ice twelve feet long, four feet wide and four feet high; it was very white and seemed perforated. We passed quite near it; the sea was smooth and several people saw it."

It is to be hoped that the renewed interest in Antarctic exploration, now manifest in Europe, will bear good results, and that the bold explorers sent out will solve the question of the origin and nature of these gigantic ice masses. Knowing this, it will remain for shipmasters faithfully to report all ice sighted, together with observations of wind, weather, temperature of sea-water and air, currents, etc., before we can fully trace the history of the ice mass from the time of its first formation till it finally disappears in the waters of the temperate zones.

In the preparation of this essay, and in addition to the large number of ships' logs, I have consulted the following books, charts, etc.: "Antarctic Explorations," G. F. Griffiths, Smithsonian Report, 1890; "Glacial Geology," Prof. James Geikie, F. R. S., Smithsonian Report, 1890; "Deep-sea Deposits," A. Daubree, Smithsonian Report, 1893; "South Pacific Ocean Directory," fifth edition, A. G. Findlay, London, 1884; "Icebergs in the Southern Ocean," H. C. Russel, Sydney, 1895; "A Popular Treatise on the Winds," Ferrel, New York, 1893; "Theory of Winds," Capt. Charles Wilkes, Philadelphia, 1856; "American Practical Navigator," Bowditch, revised edition, Bureau of Navigation, Navy Department, Washington, D. C., 1896; "Climate and Time," Croll, Edinburgh, 1885; "Encyclopedia Britannica"; "International Ice and Derelict Code of Signals"; "The Liverpool Mercantile Service Association Reporter, 1895"; North Atlantic Pilot Charts for June, July and August, 1894; "Report of Ice and Ice Movements in the North Atlantic Ocean," Ensign Hugh Rodman, U. S. N., Hydrographic Office,

Washington, 1890; "Memoir of Danger and Ice in the North Atlantic Ocean," Bureau of Navigation, Navy Department, Washington, 1888; "Report of Ice and Ice Movements in Bering Sea and the Arctic Basin," Ensign Edward Simpson, U. S. N., Hydrographic Office, Washington, 1890; various reports on file at the Hydrographic Office, Navy Department, Washington, D. C.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

TARGET PRACTICE AT SEA.

By Lieut. W. J. Sears, U. S. N.

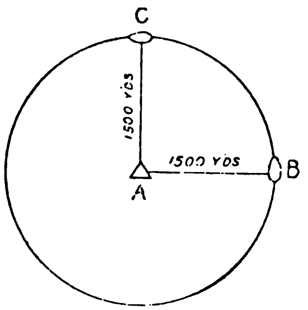
It appears from recent instructions in regard to the subject that it is considered possible to simplify the method of conducting target practice. This probably includes the preparation for practice, the method of obtaining data with which to prepare the records, and the reports of the practice, as well as the method of actually conducting it.

It may be assumed that the primary object of target practice is to teach the men to load and fire the guns quickly and accurately. The methods of obtaining data for keeping the records should, therefore, interfere as little as possible with quick and accurate firing. At the same time it is evident that at least a fairly accurate method of keeping the record must be used, or the interest in the practice will cease with the practice itself, and much of the benefit, for future use and reference, will be lost. Under ordinary circumstances extreme accuracy of observation is seldom attained, and great refinement in plotting is therefore hardly necessary. As much credit may be given then to the gun captain who hits a target two hundred feet long and twenty feet high as to one who makes a bull's eye, unless bull's eyes are his specialty and he makes them frequently.

It will probably seldom happen in action that the guns of our vessels will be fired with ships at anchor, except, perhaps, in the case of bombardment. It would, therefore, appear to be advisable to teach our gun captains from the beginning to fire from the ships while under way. Two methods will be proposed for this: 1st, one in which the bearing and distance of the target remain constant, or approximately so. This would take the place of the present stationary target practice. 2nd, one in

which both the bearing and range are constantly changing, as in our present moving practice.

First Method.



But one target is used, which is dropped overboard, when ready to begin the practice, at *A*. The ship then steams away from the target, say 1500 yards, and brings it abeam, as at *B*. She then steams around the target in a circle, with either port or starboard helm (according to the battery firing). All that is necessary to do this is to keep the target always bearing abeam. This method was recently used on board the San Francisco and was very successful, the ship maintaining a generally uniform distance of 1500 yards from the target, the limit of variation at any time being only about fifty yards. The target practice was excellent, and the fall of the projectiles about the target surprisingly uniform.

Observers.

Four observers are necessary, all on board ship, as follows:

One to take the time and number of the shots as fired from the guns in sequence.

One to note the range (so that the ship may be kept within the desired one, and also to furnish data for plotting); this may be done by Buckner's method or with the Fiske range finder.

One to observe the distance the shot strikes from the target, using Buckner's method.

One to observe the angle, right or left, from the target to the spot where the projectile strikes.

All shots striking at an angle of not more than $1\frac{1}{4}$ degrees to the right or left of the target may be considered (at 1500 yards range) as striking a target extending 100 feet to the right and left of the target fired at, provided the vertical distance is not too great or too small. For horizontal plotting, on a scale of one inch to twenty feet, the following may be used:

$\frac{1}{4}^\circ = 1$ inch; $\frac{1}{2}^\circ = 2$ inches; $\frac{3}{4}^\circ = 3$ inches; $1^\circ = 4$ inches; $1\frac{1}{4}^\circ = 5$ inches (limit to target 200 feet long).

For vertical plotting, take the distance short, or over, from the target that the projectile strikes, from Buckner's tables; with these distances pick out the vertical co-ordinates from table III of the "Tables for plotting gun practice," now furnished to ships.

The data for this method is easily obtained without interfering with or delaying the practice in any way, the shots are quickly plotted and the record is easily made up after the practice is over. But one of the most important points with this method is that the firing is continuous from the moment of commencing with one battery until all the guns on that side have fired their allowance. The firing is therefore spirited, and a lively interest is taken in it both by officers and men. It is much more natural that this should be so than in a practice which is interrupted by the ship swinging (at anchor) so as to prevent certain guns from bearing on the target, or smoke hanging around the ship so that the target cannot be seen. At the same time the method is as simple as though the ship were at anchor. Still, it may be considered preferable to anchor the ship, and if so, desirable places are easily found in our own waters; but this is not always the case on foreign stations, and such places where target practice with great guns can be carried on without offense to or objection by foreign powers are sometimes found with difficulty, if at all. By dropping the target and steaming around it in an approximate circle, as just described, target practice may be had at almost any time when a ship is at sea. It also takes considerable time to anchor, send out a target, place the buoys now used on each side of it, and station the boat containing the right or left observer.

A disadvantage of the present method of stationary practice (and in fact of all methods of practice requiring observers in boats) is that a smooth sea is necessary to make the boat observations of any value. A smooth sea may ordinarily be found in such favored places as Long Island Sound, Gardiner's Bay, Chesapeake Bay, and around Key West. But on foreign stations it is otherwise, and considerable difficulty is sometimes experienced in finding a favorable place for target practice with our long-range guns. A case is recalled when target practice commenced under such circumstances on a foreign station. The sea was smooth, and there was but little wind. Shortly afterwards a moderate breeze sprung up, but there was not enough wind to interfere with the firing. The short, choppy sea gave the observers' boats considerable motion, however,

and it was found that their observations were of but little value in plotting the shots to make up the record. This could not have happened if the observations had all been made from the ship.

It is to be regretted that Buckner's method is the only one that appears at present to be feasible for the complete observation of fall of shots from the ship, as it is not very accurate, and for that reason probably has become obsolete. But it gives, perhaps, as good results as observations taken from boats, except under favorable circumstances, and it is not always convenient to wait for such conditions. If the method involving the use of Buckner's tables will give results sufficiently accurate to furnish data from which to draw conclusions to enable us to correct the gun captain's firing, and also make up a record with which to compare the various gun captains' marksmanship, it is sufficiently accurate for our purposes.

Second Method.

MOVING PRACTICE.

The objects in this method will be:

1st. To maintain a continuous, spirited firing from either the starboard or port battery from the time of commencing until all the guns of that battery have fired their allowance. The men would probably take more interest in the practice than they would if the ship steamed over a short range on one course for perhaps only ten minutes and then spent some little time to turn and get on the range to steam back. It is tiresome and uninteresting to stand at the guns waiting to fire.

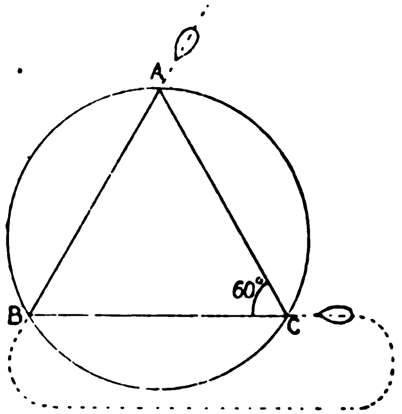
2d. To lay the targets out quickly and easily and commence practice with but little delay.

3d. To have practice at sea at almost any time.

4th. To use no boats for observers; practice can then take place under circumstances of wind and sea that would make it impossible to have it if boats were used.

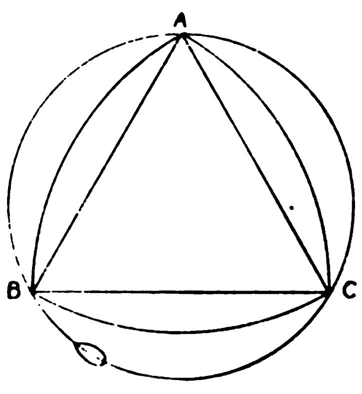
The system proposed is to use three floating targets, all alike, so that once dropped from the ship they will drift at about the same speed and maintain approximately their relative positions from each other.

Suppose the ship to be steaming along at a uniform speed, the first target is dropped, which we will call target *A*.



After steaming say 1500 yards on the same course, the second target, *B*, is dropped. The third target, *C*, is dropped by bringing either *A* or *B* on the proper bearing and steaming towards it until the angle between *A* and *B* (set on a sextant) gives the correct position to drop *C*. In the figure the ship is steaming towards *A*, where she drops the first target. Without changing course, she steams 1500 yards and drops the second target at *B*. She then changes course, as shown by the dotted line, and steams around until she brings *B* on the proper bearing, when she steams slowly towards it, keeping it on the proper compass bearing. When the angle between *A* and *B* is 60°, the target *C* is dropped; the ship then steams around all three targets, firing at them in succession until the allowance of ammunition for the battery on that side is expended. She then turns and steams in the opposite direction, mans the other battery, and fires until its allowance is expended.

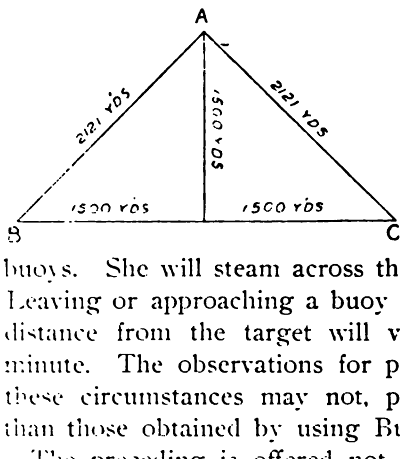
Suppose the starboard battery to be the first one to fire. After dropping target *C*, the ship steams in the direction of *B* and gets on the circumscribed circle. When she gets near *B*, she opens fire on target *C* at 1500 yards range, turning gradually towards *A* with a port helm. If she follows the circle, the distance steamed from target to target will be 1815 yards, and the greatest distance from the ship to the target fired at will be 1733 yards. But by following the inner arc of a circle, struck from *C* as a center, the distance from *C* would be constant, and



would be 1500 yards. This is a special case of the first method described, using a single target, and should be avoided to give the gun captains practice in training their guns. When the ship arrives at *A* the target *B* is fired at until *C* is reached, when *A* is fired at until the ship arrives at *B*. The same observers are required as in the one target method, already explained. The plotting is done in the manner described for that method.

On soundings, the targets could, of course, be anchored; but the advantage of the method (if there is any) would be that it could be used at sea off soundings under circumstances when observers in boats could only obtain observations that would be of but little value in plotting the shots. This might be of considerable importance on a foreign station where there may be difficulty in finding a good target ground outside of foreign jurisdiction.

It seems quite probable that objection will be made to the use of Buckner's method. But is the present method of observation and plotting always more satisfactory than this would be?



Suppose that with the present method a target is laid out at *A* and the ship steams over a range between two buoys, *B* and *C*, 3000 yards apart, at a speed of ten knots, firing at the target *A* while between the buoys. She will steam across the range in about nine minutes. Leaving or approaching a buoy at either end of the range, the distance from the target will vary 200 yards in less than a minute. The observations for plotting the fall of shots under these circumstances may not, perhaps, be any more accurate than those obtained by using Buckner's method.

The preceding is offered not in any sense as a criticism of present methods, but merely as a suggestion of methods that may, under certain circumstances, be more advantageously employed in target practice on board our cruisers, particularly on board those on foreign stations.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

NAPHTHA FUEL FOR WAR-SHIPS.

By Lieut. M. Vasilieff, Russian Navy.

Translated from the Russian (Morskoi Sbornik, August, 1896) by Lieut. John B. Bernadou, U. S. N.

In submitting a sketch of the development of the employment of naphtha fuel for war-ships, I do not pretend to say much that is new; but information on this subject is so little spread in our Navy that even an elementary sketch should contribute its share of usefulness, especially in view of the probable employment of naphtha fuel on ships of war in the very near future.

First of all, the naphtha serving to heat steam boilers should not be confounded with *raw naphtha* or *kerosene*. Both of these latter substances are easily inflammable, as they contain various more or less volatile hydrocarbons (on account of the presence of which they possess a characteristic odor), while the naphtha which we are now considering, and which is commonly called "mazut,"* is the residue from the distillation of raw naphtha after the kerosene, benzene and other coal derivatives with low ignition points have been expelled therefrom. Naphtha residue is a yellow brown, thick oily liquid; its specific gravity and ignition temperature depend upon the degree of distillation to which the raw naphtha has been subjected, or upon the temperature at which the process has been conducted. For general purposes of navigation the residue is completely safe when it possesses a specific gravity 0.92 and an ignition temperature

* This substance is hereafter referred to in this translation as "naphtha residue."

of +140° C. Such a residue possesses a very faint odor, and gives generally negative results in all attempts to inflame it. It is not set on fire when burning tow, pine splinters or burning signal lights are thrown upon its surface, and when drops of molten metal are projected into a pail of the residue inflammation only occurs around the stream of metal, and the fire is immediately extinguished when the last drops of metal disappear below the surface of the fluid. In order to consume the whole it is necessary to raise the entire mass to its ignition temperature.* Firing into the residue with projectiles and bursting shell does not serve to ignite it. As it consists of a mixture of stable chemical compounds, this substance is not liable to spontaneous combustion, and as far as fire is concerned it is safer in a ship than coal. The superiority of naphtha residue as a fuel compared with coal may be seen from the following:

One pound of coal burned in the furnace of a steam boiler evaporates in practice 7 pounds of water, and one pound of the residue consumed by means of the Petrashevsky and Shtchensnovitch Steam Burner evaporates under the same conditions 13.7 pounds; consequently the heating power of the naphtha residue compared to that of coal is nearly twice as great.

With skilled firemen, absolutely smokeless combustion may be produced if, at the same time, there be not forced through the furnace too large a volume of air, the most favorable amount being only one and one-half times that required theoretically for the complete combustion of the residue; under such conditions the boiler then receives from 78 per cent. to 84 per cent. of all the heat developed.† It is possible to determine the exact composition of each different sample of residue empirically, as it consists of a mixture of various hydrocarbons in the series of the form C^nH^{2n-2}, in which the fundamental content of hydrocarbons of the various indices *n* is an indeterminate quantity.

However, naphtha contains a certain quantity (sometimes as high as 5 per cent. of its volume) of water and also earthy matters.

* [illegible] with flame this produces evaporation.

† [illegible] as high as 90 per cent., while coal and wood, even under the [illegible]ble circumstances, do not give more than 60 per cent.

The greater the specific gravity of the naphtha, the more difficult it is to separate the water from it by allowing it to stand, as is easily understood. This admixture with water is injurious, as it lowers the temperature of the flame upon combustion; and the earthy particles, even when very fine, obstruct, scratch and wear out the naphtha ducts when they fall into the burner, which leads to an increased expenditure of naphtha, injury to the burner, and change in the form of the flame. Hard particles are gotten rid of by settling and careful filtration of the residue.

According to Saint Clair de Ville's analyses:

Variety.	Spec. Grav.	Composition. C.	H.	O.	1 lb. Naphtha evaporates in lbs. Water.	Heating Power.
Raw naphtha,	0.882	87.4	12.5	0.1		11,700
Naphtha residue, Baku factories,	0.928	87.1	11.7	1.2		10,700
Light Baku naphtha,	0.884	86.3	13.6	0.1	16.4	11,460
Heavy Baku naphtha,	0.938	86.6	12.3	1.1	15.55	10,800

The above table of analyses shows that in point of composition raw naphtha differs but little from naphtha residue, and even surpasses it in heating power. As the residue represents a product of technical industry, it naturally costs the more, and this is the reason why it has hitherto been supplanted by the other material for use in heating steam boilers. To render raw naphtha innocuous in relation to its liability to ignition, it suffices to expose it to the air in flat, open vessels whereby the volatile ingredients gradually pass off by evaporation. Fresh raw naphtha that will ignite at about 40° C. is found after a week's exposure to the air to ignite at +60° C., and after two weeks at +70° C., while simple heating will raise the ignition temperature still higher.

The majority of specimens of raw naphtha are more liquid than the residue, and therefore their consumption will be greater for the same type of burner and the flame larger. It may be that this difficulty will eventually call for a corresponding change in burner and bricklaying in all cases where burners specially designed for use are employed. Calculation shows that for the full combustion of one pound of naphtha residue of composition as shown in the table, 155.5 cubic feet of air are required. This

theoretical quantity must be increased in pra one-half times this amount, when the tempera becomes 1500° C. Notwithstanding such a *the boiler suffers less* (with the correspondin furnace) *than with coal,* as the flame from the impinge directly upon the tube sheet, but stri or gates of the fire-brick lining, while the n the boiler comes in direct contact only with th of combustion—carbonic acid, steam, carbon

The *tubes do not choke* and do not require the ing with a brush. Every one knows how muc from the firemen when under way under fo they can do is to throw the coal in the furnaces, coal from the coal-bunker into the fire-room requires the aid of the crew, which could not of action or while anticipating it; and it might the anticipation might be prolonged until became more or less exhausted, while during time heavy masses of thick smoke, objectiona would continue pouring forth from the smo the same circumstances liquid fuel would cont into the furnaces; *forced draught does not ca increase of labor on the part of the fireman.* wide the steam and naphtha valves of the burn tilators, and having regulated the rate of com ing to do but watch the level of the water in burner happens to choke up, it can be clear by blowing steam through it; if the strainer of chokes, it is easy to remove it and clean it b through it from the water-cocks. These ac that happen most frequently when liquid fuel are generally caused by fragments of cloth or the bungs of the casks in which the naphtha i ing into the liquid and eventually finding th burner.

If coal-bunkers were perfectly tight and did tional bulkheads for retaining the naphtha v the comparative heating capacity of such res made apparent by the following simple calcu of coal is able to evaporate 17,360 pounds of

the volume of one ton as 45 cubic feet; the weight of the same volume of naphtha residue would be 1.143 tons, and this amount would suffice to evaporate 39,406 pounds of water, that is, the amount of heat included in the same volumes of coal and naphtha is in ratio to each other 1 to 2.27. Practically this ratio is less, as the naphtha reservoirs on shipboard require for various reasons numerous bulkheads. Such bulkheads are indispensable to avoid the use of convex walls, to prevent splashing and movement of the fluid due to the roll of the vessel, the considerable loss of the liquid that might be caused by a local injury to the receptacle, etc. If ship's reservoirs were so constructed as to enable even one-half of the advantage of the naphtha as calculated on the basis of weight to be made good, then the radius of action of the ship would be increased by 60 per cent.

The ship that is fully provided with liquid fuel is lifted out of comparison with another in point of quick, clean firing, which, moreover, does not necessitate prolonged labor nor exhaust the strength of the crew. *The delivery of the naphtha residue from ship to ship may be perfectly accomplished at sea even in comparatively fresh weather* if the naphtha transport, provided with a delivery tube, takes the ship to be provided by it in tow. *The control of the amount of fuel delivered and expended may be made perfectly automatic, and, therefore, perfectly exact.*

The expenditure of the residue in raising steam to a certain pressure does not exceed 10 to 15 per cent. of the expenditure under the same conditions when under way. To maintain steam at anchor is still more economical; *e. g.*, when carrying from 100 to 120 pounds, extinguish the burners and close fire-room doors and smoke-pipes; then at the end of from 10 to 12 hours there will be yet enough steam in the boilers to operate the burners, and in a quarter of an hour the pressure can be run up to the working limit, after which, if it be not required to get under way, extinguish the burners and re-cover all. In such a case there is effected, first, a very moderate expenditure of fuel and one in proportion to actual needs; and second, the fire-room force have full rest while at anchor. If the vessel be suddenly brought to anchor the burners can be extinguished, and thus at once the expenditure of fuel and the formation of steam are stopped.

If the reservoir be perforated by collision, then, the naphtha

being lighter than water, flows out only up to the level of the hole and all above this level remains in the receptacle. A reservoir pierced at the top and filled with water increases in weight about 10 per cent.

Some ships are provided with coal-bunkers that serve to furnish shelter to certain portions of the vessel; in such event the naphtha naturally affords the weaker protection; but it is possible a ship may be compelled to go into action when her supply of fuel is nearly exhausted, when the coal-bunkers would not serve the purpose of armor, and in such a case the naphtha reservoirs, which are more strongly built and are provided with more numerous bulkheads, might prove impenetrable for light projectiles where an empty bunker would be pierced by every shell. In general comparison the naphtha fuel would not be at a disadvantage.

In getting up steam with liquid fuel, primarily, wood is used; if time permits, it may be employed for a single boiler, by the aid of the steam from which the burners of the other boilers may be lit. In large vessels, where steam is constantly maintained, this necessity disappears; while in small ones, such as torpedo-boats, it is a question of the expenditure of a small amount of wood, after which it is so easy and cheap to maintain steam that it is better not to haul fires, except for prolonged anchorages and where a new supply of wood may be obtained. It is better, too, for the preservation of the boilers not to subject them too frequently to considerable changes in temperature, such as arise in the getting-up of steam and the hauling of fires.

Finally, as concerns the preservation of the ship, it is recommended to store the naphtha in those parts of the double bottom and lower surfaces where access for cleaning and painting is most difficult, for naphtha, as experiment shows, proves an excellent preventive to the formation of iron rust.

In firing with naphtha the residue is burned either by igniting it from tubes from which it is projected in a continuous stream, or else by pulverizing it beforehand by means of air or steam. The first method is applied successfully enough to certain shore boilers; the pipe system is evidently unsuitable for marine boilers on account of the rolling of the ship. For the present-day types of high-pressure marine boilers the pulverization of the naphtha becomes necessary, as it leads to the development of a more

perfect combustion and a higher temperature of flame. Judging from the quantities of patents and privileges granted inventors, steam burners of very different types have been employed for pulverizing the naphtha. Devices of this kind, however, represent no discovery, but only more or less successful applications of the pulverizer idea to the needs of liquid fuel. The steam enters the burner at a pressure of about 45 pounds and over; it passes through the steam ducts into the furnace, disperses, and, meeting upon its exit the stream of naphtha, pulverizes it; the mixture of steam, naphtha dust and air, artificially directed and impelled by its weight, burns.

The steam and naphtha ducts in the burners are made of various shapes—straight and annular, by which the flame is given a fan-shaped or conical form. As already stated, the flame is made to impinge upon the fire-brick lining in such a direction as to effect the most advantageous admixture of naphtha, steam and air, and to produce complete combustion of the fuel, as is indicated by the color of the flame.

The arrangement of the burners is satisfactory when the flame is bright and brilliant, filling the whole furnace; if it be not so (red spots and dark areas are seen), then, by changing the direction of the burners and their connections, or the form of the brick lining, the combustion may be brought to the desired degree of efficiency.

Experiments for the use of naphtha fuel for marine boilers have been in progress in our Navy for some years, and at length, in 1895, results have been obtained which afford the assurance of the speedy, practical solution of this question.

In the Caspian Sea, on the Volga, steamers have now been using naphtha fuel successfully for the last twenty years, so it may be assumed that sufficient experimental data have been collected to serve as a guide in developing the needs of war-ships. In reality, however, the problem is far from being a simple one, for the practice of ships in the Caspian and on the Volga differs materially from that which would have to be followed on ships of war. On the Volga, and especially in the Caspian, naphtha is cheap, and steam boilers are fed with water taken over the side, so that there is no specially urgent reason for minimizing the expenditure of naphtha and steam in operating the burners; smokeless combustion and successful maintenance of steam is all

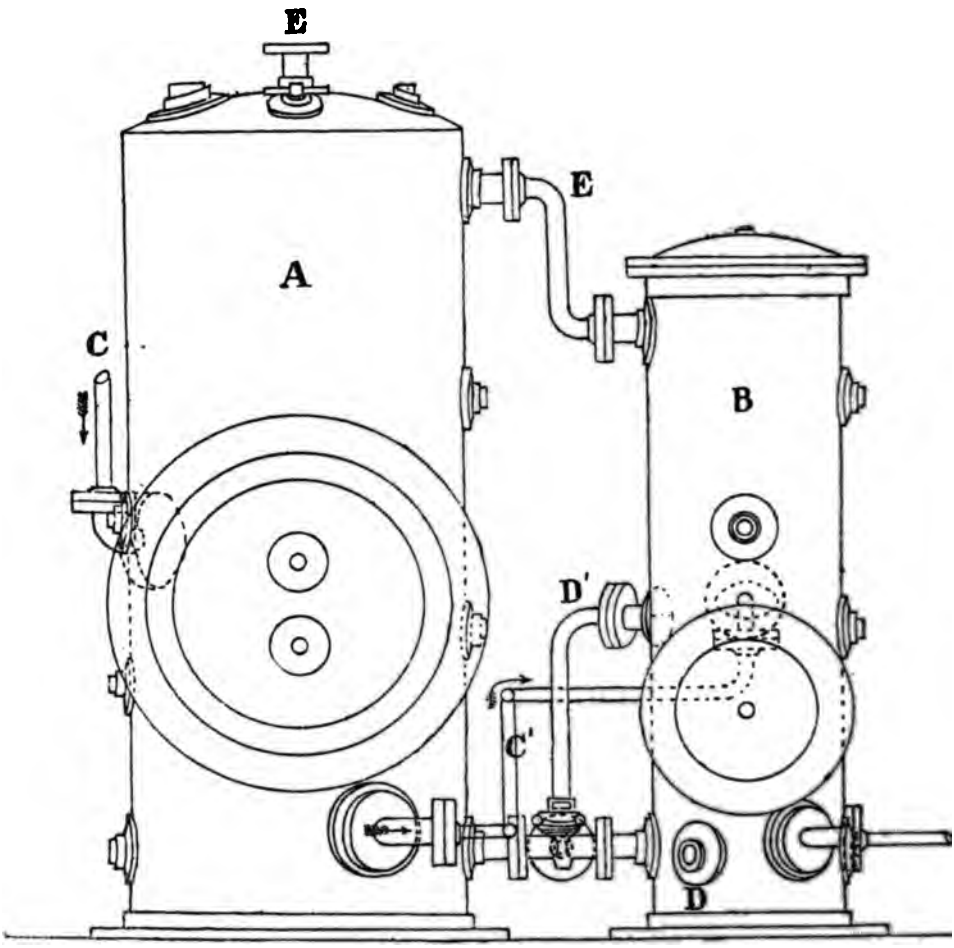
that is required. In a war-ship it is all-important to possess the capability of steaming the greatest number of miles with the given supply of fuel; therefore very economical burners would have to be employed, and besides, as all present-day types of steam boilers require to be fed with fresh water, the employment of steam from the boiler for the pulverization of naphtha would become a very serious obstacle to the application of liquid fuel on war-ships. The quantity of steam expended in operating the burners and lost by escape into the air through the smoke-stack amounts, with skilled firemen, to from three to five per cent. of the whole steam developed by the boiler; and no present-day type of fresh-water condenser is able to make the loss good. In this way there is presented to experimenters the option either to find a way of pulverizing naphtha besides that requiring the use of steam, or else to design a condenser capable of making good the loss of water caused by the burners. Following the first idea, burners have been proposed in which steam is to be replaced by compressed air, to obtain which ships' air compressors and accumulators are to be used; but by making a liberal allowance, the torpedo-boat Viborg, when running at mean speed, would require air compressors fifteen times more powerful than she carries, which, while very heavy, would occupy much room and would require additional attendance (all serious matters on a torpedo-boat). The compressed air itself, on its exit from the burners into the furnace, would lower the temperature of the flame through its expansion, which argues against the utility of this type of apparatus.

On the other hand the steam which is used for pulverization impinges at a high temperature upon the fire-brick lining of the furnace, dissociates, and the products of its combustion reunite to produce a flame of high temperature.

In May, 1895, at the commencement of the cruising of the torpedo-boat Viborg, information was received from our naval agent in England concerning an air compressor with uninterrupted action for burning naphtha which a London firm had gotten out. According to information furnished, this device was too clumsy and heavy for torpedo-boat use, and besides it delivered air at a pressure not high enough by one and one-half atmospheres, one which, even with the comparatively economical Petrashevsky and Shtchensnovitch burner, would only serve for mean speed.

The burners with mechanical pulverization make a somewhat better showing. With apparatus of this type the naphtha is preliminarily pumped into a special reservoir in which it is subjected to a pressure of between 75 and 100 pounds by a hydraulic pump; the stream of naphtha is driven at this pressure into the burner, where it strikes a specially shaped edge or rib which disintegrates it into dust. The Svenson burner, one of those constructed on this plan, was tried with some success last year on the Viborg; it gave a good flame and smokeless combustion, but could not burn the requisite amount of naphtha; before expressing a final opinion about it further experiments must be made, and the inventor is now at work on these himself. Fully comprehending that the best burner is one of the steam type, capable of being employed without requiring steam from the boiler to operate it, the officer in charge of experiments with liquid fuel, Captain, senior grade, N. X. Yenish, hit upon the idea of an evaporator in which the pressure of the secondary steam would be sufficiently high to operate the burners, the steam being formed so as not to interfere with the uninterrupted working of the latter. Such a device was designed* and developed at the establishment of R. Krug, St. Petersburg, and installed in the starboard fire-room of the torpedo-boat Viborg. This apparatus, called by its constructor a *high-pressure evaporator*, consists, as shown in the accompanying sketch, of two communicating copper cylindrical vessels, *A* and *B*; the first is the evaporator proper, and the second a heater for the feed water, which enters at the side through the tube *D* and flows freely by the tube *D'* into the evaporator *A*. Steam from the boiler enters the evaporator by the tube *C* and, passing through the coils (in series; not shown in the sketch), heats the water in *A*; then flows by the pipe *C'* into the feed water heater, where it is cooled and finally passes through *C''* into the hot well. The pipe *E'* unites the steam spaces of both parts of the apparatus, in consequence of which the pressure and level of the water is the same in both. The secondary steam passes into the burner from the upper part of the evaporator by the tube *E*. Water glasses and cocks are provided for indicating the level of the water, while the pressure is indicated by a special gauge.

* With the aid of Shiloff, engineer-mechanician, who has done much work in connection with experiments on liquid fuel.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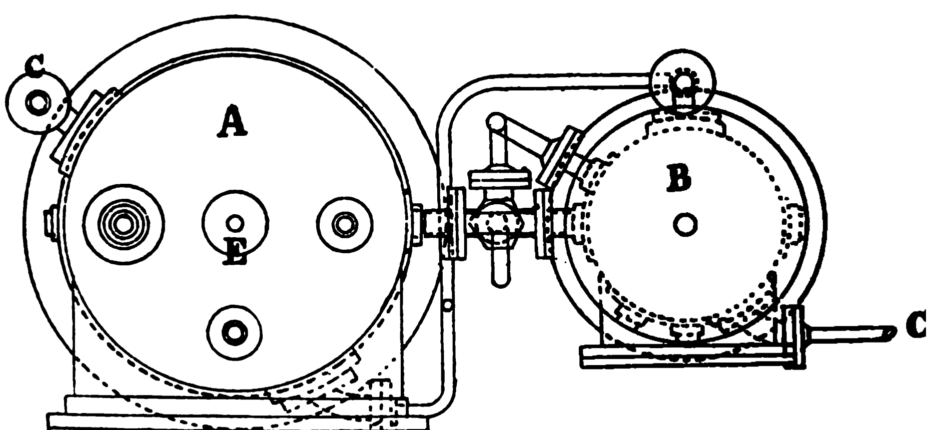
C
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As installed in the Viborg, the evaporator and mount weighed about 25 poods (1000 pounds), took up very little room and, although not provided with lagging, did not raise the temperature of the fire-room to any appreciable extent. In the following experiments made while under way the apparatus was fed with an artificially prepared solution of sea salt, of the density of sea water, with a boiler pressure between 90 and 95 pounds (250 revolutions, speed about 14 knots); the pressure in the heating coil of the evaporator was about 82 pounds, and of the secondary steam 40 pounds; the expenditure of feed water for operating both boilers (four burners) was about 59.6 gals. per hour, and the amount of naphtha burned was 33 poods (1320 pounds). The heating surface of each boiler was 107 sq. m. (1151 sq. ft.) For the general trial of the evaporator a run was made from Helsingfors and back to St. Petersburg; the results of these trials were reported as follows: "20 September, 1895, steam was gotten up in both boilers of the torpedo-boat, and when at 90 pounds the evaporators were started, commencing at the same time then to feed with artificial sea water (of density by salinometer of $\frac{1}{32}$ at 70° R.). The secondary steam from the evaporator was led into four burners, two of which were of the Petrashevsky and Shtchensnovitch and two of the Yanusheff system. The steam valves were opened wide. At first the evaporator showed by its action (as indicated by water glass and drain cock on pressure gauge pipe) that violent ebullition was taking place within it, which was accompanied with a projection of the water into the steam ducts of the burners. The projection of water stopped when the feed valve of the evaporator coil was partly closed. The causes of the violent ebullition of the water in the pulverizer may be taken as (1) the presence of a considerable quantity of dirt in the water, which came from the sea salt as purchased; (2) a too great ratio of heating surface to volume of water in the evaporator.

The salt water carried over by the secondary steam was deposited in the steam ducts of the burners, but was projected into the furnace without clogging them. The quantity of this water was so small that it exercised no injurious effect on the combustion of the naphtha in the furnaces. To form an estimate of the amount of deposit on the surface of the heating coils, the evaporator was blown through about every two hours, when nearly the

whole of the water in it was renewed. Durin the trials the pressure of the secondary ste uniformly, and this pressure preserved a cer of the steam in the boiler; on increasing the was increased in the evaporator and *vice vers* in the heating coils was maintained at a certai of the feed valve, the variation of the pressure boiler did not produce a fluctuation in that of which constitutes an advantage of this evap ratus for effecting the pulverization of napht regulation is easily effected by feeding in a c supply of fresh water.* It is to be noted t pressure in the secondary steam did not depe of naphtha consumed; the Petrashevsky a burners did not smoke. During the feeding the pressure fell 3 or 4 pounds, but upon stop it immediately ran up again.

On blowing out all the water the pressure extinguishing the burner the feed valve was and the formation of the steam stopped at on of the supply of steam to the burners may be the valves on the burners themselves or else t the hot water heater coils. This capability in of this evaporator as an apparatus for effecti of the naphtha.

The torpedo-boat rolled heavily at the tim evaporator, but the rolling exercised no infl formance; the level of the water in the gaug the foaming did not increase. During the se the foaming of the water in the evaporator projection of salt water into the burners cease on the third day this projection was hardly n be noted that the foaming stopped when the coils became covered with a layer of scale quantity of heat and its speed of delivery reduced. After 30½ hours' trial the evapo water heaters were opened, when it was foun

* Unfortunately the Viborg's feed pump was too of which it became necessary to stop it from tim evaporator could not be fed uniformly.

the heater coils was perfectly clean, while the evaporator coils were covered with a layer of scale of a thickness of 1¼ mm. for the upper spirals, of ⅛ mm. for those in the middle, the lower coils showing scarcely a perceptible amount of deposit. This deposit did not impair the evaporative efficiency of the apparatus, and the fires continued to effect a smokeless combustion and to burn the same quantity of naphtha residue as they had burned at the beginning.

The scale can be easily removed from the upper spirals by jarring them with the hand, and from the lower ones by cleaning; to effect this the spirals are removed from the evaporator, which may be done easily and quickly. Speaking in general terms, the Krug evaporator, as an apparatus for effecting the pulverization of naphtha by steam, accomplished its purpose successfully during the whole of the experiments, and delivered to the burners a quantity of steam sufficient for the smokeless combustion of about one and one-half times the quantity of naphtha required by the torpedo-boat for running under forced draught.

Mr. Krug proposes to make certain improvements in later apparatus of this kind, such as (1) constructing the shells of the feed water heater and evaporator of steel instead of copper, as they will then stand greater pressure and, besides, will weigh less; (2) fitting both these vessels with salt water blow cocks, the need of which was felt from the beginning of the experiments; (3) introducing the feed water at the top instead of at the bottom after blowing completely through, so that the hot coils will cool throughout simultaneously and, through their change of form, will effect their own cleaning; (4) constructing the tubes of elliptical instead of circular section, so as to effect maximum deformation on contraction and expansion, etc.

Summarizing what has been stated above, the advantages that have been developed by trial for naphtha residue for fuel for ships of war are its safety as a combustible; its numerous advantages over and its superiority to coal as a fuel; the superiority of pulverization by steam over that effected mechanically or by use of air; and the accomplished development of a successful type of steam pulverizer, etc.

However, certain problems of secondary, yet of great importance remain to be solved, and experiments must be repeated upon a larger scale by way of verification of results already

obtained. One of these questions, propounded by Captain, 2nd rank, Gavriloff is worthy of a special mention. It relates to the effect of a submarine explosion upon the walls of a reservoir entirely filled with naphtha in which the pressure of the liquid is distributed equally in all directions. Systematically conducted experiments can alone determine how disadvantageous liquid fuel would prove in such a case and to what extent this difficulty may be overcome.

Further experiments will be made during the present summer with liquid fuel in the Baltic on board the Viborg, which has been definitely assigned to the work, and upon one torpedo-boat supplied with a Yarrow boiler. On the Black Sea a torpedo-boat is being fitted out for the use of naphtha residue (formerly the Novorossisk); and trials may be made on board the torpedo cruiser Kazarski and the ironclad Rostislav.

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U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

DEVELOPMENT OF ORDNANCE AND ARMOR IN THE IMMEDIATE PAST AND FUTURE.*

By P. R. ALGER, Professor of Mathematics, U. S. Navy.

The object of my paper to-day is to bring to your attention and to discuss recent developments in ordnance and armor, and to point out the direction of probable further advances. Enormous strides have been taken by both the offense and the defense in naval warfare since the days of smoothbores and wooden walls, but there is room for further progress, and although this will probably consist almost entirely in the perfecting of details, yet to the navy most successful in doing this may come the reward of a decisive superiority.

It is an axiom that the success or failure of any mechanical device, complex or simple, lies in greater or less perfection of details, and this is perhaps truer of ordnance than of anything else. The best guns and mounts are useless if the primers or sights are defective; the best projectiles are of little value if their fuses fail. Of course the prime factors for success are skill and zeal on the part of those who handle the guns, but these qualities granted, then the difference between perfection and inefficiency lies in the working out of details.

Let us commence then with the gun and consider what is being done to increase its efficiency and what more can be done. The desirable qualities in a gun are safety, power, accuracy, rapidity of fire, and cheapness. Safety and cheapness depend upon material and method of construction; power depends upon

* The first of two lectures delivered before the Naval War College, Newport, R. I., in the summer of 1896.

[illegible] caliber, and length of bore; rapidity of fire de- [illegible] upon the system of breech closure; accuracy [illegible] the gun itself is concerned, on workmanship. [illegible] material and the built-up methods of con- [illegible] almost universal use, and the records of [illegible] service firings show that they furnish an [illegible]. Wire-wound guns are coming some- [illegible] superiority over built-up guns, either as [illegible] cheapness, is trifling or non-existent. I sup- [illegible] informed person doubts that an efficient, safe and [illegible] be made of cast steel or can be forged in one [illegible] manufacture of such guns can only be defended on [illegible] cheapness and rapidity of production, and they can- [illegible] in any sense equal to guns built on the present [illegible] appear, therefore, that there has been no [illegible] made in the art of gun-building in the recent [illegible] likely to be any in the immediate future, and I [illegible] fear of our present guns becoming obsolete [illegible].

[illegible] gun depends on its caliber, length, and the [illegible] chamber. Taking a gun of any given caliber, [illegible] power almost indefinitely by increasing the [illegible] chamber so that it will contain more and more [illegible] same time increasing its length of bore so that [illegible] time to burn; but this method is so expen- [illegible] weight and money cost, besides involving [illegible] in handling and supplying ammunition, that [illegible] lines ceased some years ago.

[illegible] has fixed the size of the powder chamber of [illegible] which permits the use of a brown powder [illegible] the weight of the projectile, which itself [illegible] half the cube of the caliber in inches, and [illegible] advantages which would attend any very marked [illegible] practice render a radical change improbable. [illegible] power by lengthening the bore, however, [illegible] to an extent which seems to me to be [illegible] appears to be, on mistaken notions as to the [illegible] powders, whose introduction has been followed [illegible] guns of sixty and even eighty-caliber [illegible] brown powder an increase of length of

bore from 40 to 50 calibers adds but about 100 f.s. to the muzzle velocity of a large gun, and less than that to the muzzle velocity of a small gun; and with the new smokeless powders, for reasons which I shall point out later on, the gain from increase of length is even less. To compensate for this slight gain in velocity we have increased weight, cost and difficulty of manufacture, with decreased mobility. I think it quite certain that an increase of length of bore beyond 35 or 40 calibers is inexpedient and that there will be no marked future progress in this direction.

The true method of increasing power is by an increase of caliber, and the most important question in regard to the gun is whether we have reached the proper limit to development in this direction, or whether we shall find it desirable in the future to build larger guns than we now have in use or contemplation. Of late years the tendency has been the other way. Krupp and Armstrong no longer find purchasers for their 100 and 120-ton guns, and none of England's latest battle-ships carry the 16¼-inch gun. This retrograde movement was due to the fact that the power of the gun so exceeded that of armor as to render it advantageous to sacrifice the unnecessary excess for gains in other directions. The advent of hard-faced armor has put a stop to this movement, and the question now is, will future developments result in either a future decrease of caliber or a return to the largest calibers yet made and even an advance beyond them? There is no question as to the great advantages of large caliber; the larger the gun the more destructive in increasing ratio is its fire, but the sacrifices attending the use of very large guns lead us to restrict their use as much as the necessities of the case admit. If the 13-inch guns will suffice to do any work which they can be called upon to do, then we are not likely to build larger guns on the ground that the latter will do the work more easily. We must, however, have on our battle-ships guns capable of overcoming any defense which an opposing battle-ship may present to them. The question then is, are future armor developments likely to result in a protection to ships which the 13-inch guns cannot overmatch? No armor plate has ever yet been made which a good 13-inch projectile, at moderate range and with normal impact, would not perforate, and I incline to the opinion that there never will be. The power of the 13-inch gun is now limited by the strength of its projectile, which, unless

of the most superior quality, smashes on hard-faced armor, and it is more than likely that future advances in armor manufacture will be accompanied or preceded by equal or greater improvements in projectiles. I conclude, therefore, that an increase of power beyond that of the 13-inch gun will not become necessary, and consequently that no larger calibers will be adopted. As far as reduction in caliber is concerned, this would be clearly unwise at present, and even if, in the future, the 12-inch or a smaller gun develops sufficient power to overcome any armor, it is doubtful if the gain of weight due to the change will be of sufficient importance to justify it. There is no reason why the rate of fire of a 13-inch gun should not be practically the same as that of a 12-inch gun; its destructive effect is much greater; and, in my judgment, having adopted the 13-inch caliber for our battle-ships, we should, and will, continue its use in the future.

The most striking advance in ordnance in recent years has been the application of the rapid-fire principle to large guns, and it is very important to decide how far this development can be carried. We hear of 8-inch, and even 10-inch, rapid-fire guns, but the term should properly be applied only to guns using metallic cartridge cases. With such guns a quick-acting breech mechanism can be used, and the time required to prime the ordinary type guns is saved. Moreover, with calibers small enough to allow the use of fixed ammunition there is a considerable saving of time, from there being required but one motion in loading instead of two. Thus it is that the modern R. F. gun of 5-inch caliber or less can be fired in practice and without aim at the rate of 10 or 12 shots a minute; or, allowing about ten seconds for aiming, we may say that the service rate of fire of the 5-inch R. F. gun should be from 3 to 4 rounds a minute. When we go to the 6-inch caliber, where the weight of fixed ammunition would require two men to handle it, the advantage of single loading is lost, but still the saving of time from the use of the primed cartridge case is considerable, and with a well-drilled crew the service rate of fire of the 6-inch R. F. gun should be from 2 to 3 rounds a minute. The 6-inch R. F. gun is in general use already, and its great advantages over the ordinary type gun of equal caliber are now universally admitted. Can we hope to extend the R. F. system still further, or has the limit of progress in this direction been reached?

The interval between rounds with any gun is made up of

(1) the time to open breech, (2) the time occupied in cleaning gun or mechanism, (3) the time to load projectile, (4) the time to load charge, (5) the time to close breech, (6) the time to prime, (7) the time to point and fire. Considering the 8-inch caliber, let us see how these times can be reduced to a minimum and to what limit they tend. With our present breech mechanism the operations of opening and closing the breech occupy 4½ seconds each. The automatic opening of the breech during counter-recoil, which is now being used on heavy guns abroad, will save 4½ seconds time. The adoption of a mechanism actuated by a single motion, such as used on the regular R. F. guns, would save perhaps 7 seconds, 3½ in opening and 3½ in closing, but would necessitate the use of a metallic cartridge case which, as will be seen further on, has more than compensating disadvantages. Sponging or in any way cleaning out bore or chamber is an entirely unnecessary waste of time, and the only thing which should be done after each fire is to wash off the gas check with a marine sponge, which can be done while the gun is being loaded. The gun should also be primed while being loaded. The use of a primed cartridge case would, therefore, not save any time as far as these operations are concerned, neither would the use of a cartridge case save any time in loading; fixed ammunition is entirely impracticable for so large a gun as the 8-inch, so that double loading is a necessity. The use of a metallic cartridge case certainly would not make the operation of loading any more rapid, adding, as it would, some 50 pounds to the weight of the ammunition and requiring extraction and removal after each round, while at the best only saving some seven seconds on time of opening and closing breech.

The time taken to load shot and charge and to point and fire depends upon the efficiency of the ammunition, handling and gun-pointing apparatus, and upon the skill of the gun's crew, but the latter is by far the most important factor. As an illustration of this it may be said that the firing interval of our 8-inch turret guns at target practice ranges from 2 minutes to 8 or 9 minutes on different ships having the same mechanical arrangements, and, be it remarked, with far greater accuracy of fire on the ship with the smaller interval.

We must conclude, then, that with the 8-inch caliber, and *a fortiori* with larger calibers, no material increase in rate of fire can be attained by mechanical improvements in the guns them-

selves or by the use of the rapid-fire princip
in this direction in the future will be the
zealous exercise far more than of mecha

When you read that the Elswick R. F.
fired, on shipboard, 3 rounds in 30 secor
you must not conclude that the Elswick
to our own, for this is not the case. The t
the men who did the firing were well dril
record under intelligent supervision, and
equal amount of practice our 8-inch gun's c

When we leave the 8-inch caliber anothe
the weight of the projectile becomes too
hand loading. With 8-inch guns the proj
about the gun, in racks or otherwise, and l
With the larger calibers the shell must b
together with the powder charge, and
means, and the rate of fire depends alm
efficiency of the ammunition-hoist and the
ling it. A small saving of time can be
opening of the breech during counter reco
about 15 seconds at the most; and the
from acquired skill in loading and pointing
No attempt should be made to clean bore
no danger of burning material being left i
long guns now in use, and the difficulty of
loading can be overcome by the use of
lifts the axis of the projectile to the same le
A well-drilled crew should be able to fire
rate of one aimed round every two minutes
guns every three minutes or less. The g
of the 10-inch caliber is largely due to t
sections of the powder charge are not too
from the hoist by hand and inserted in the
the hoist is being lowered for another rou
and 13-inch this method, though perhap
been tried, and consequently the estimate
position that the hoist has to be stopped in
tions while the shot and the half-charges ar
home.

To sum up, it may be said that rapidity
depends far more upon the skill to be acqu

tice than it does upon further perfection of mechanical details. No man can properly control the ammunition-hoists and the elevating and training gear of a heavy turret gun unless he has learned to do it by constant exercise, and when we consider that the victory or defeat of a battle-ship will depend almost entirely upon the greater or less skill with which her turret guns are handled, surely there should be no lack of such exercise. Daily drill in handling all the mechanical appliances, and especially in pointing the guns at moving objects, should be absolutely insisted upon on every ship in our Navy, and the larger the guns the more necessary this daily drill is.

The next point to be considered is the possible increase of efficiency of gun mountings.

One considerable improvement has just been made in the carriages for broadside guns, namely, the adoption of what is known as a pedestal mounting, which enables the usual arc of train to be attained with a smaller port opening than with former mounts, and, what is of great importance, without the use of sponsons.

The most important change, however, is the extension of hand-working to the largest guns. The 12-inch guns of the Iowa will have hand-worked mounts, and so probably will the 13-inch guns of the new battle-ships, and it is well to consider how this is accomplished and just what the advantages and disadvantages of the system are.

In the first place it must be borne in mind that hand training is and always will be impracticable for heavy guns in thick-armored turrets. The Indiana's 13-inch turrets, for example, can be trained at a speed of 10° a minute by eight men when the ship is on an even keel, but the least heel will render it impossible to move the turret from the position of train on the lee beam. In future designs the turrets will be so nearly balanced as to train with about equal ease on an inclined or a level deck, but the slowness of the movement and the speedy exhaustion of the men on the cranks must always operate as a bar to the use of hand training, except in an emergency when the usual training machinery has been injured.

In the same manner, though not quite so decidedly, we are prevented from using hand power for hoisting ammunition and for loading. Rapidity of fire is too important to be sacrificed to the extent which would necessarily be the case should power hoists and rammers be dispensed with.

The elevating and depressing of heavy guns by hand has been rendered practicable by pivoting the gun slide at the center of gravity and mounting it on knife edges to reduce the friction. In this manner we make it possible for two men to move a 12-inch or 13-inch gun and slide up or down with sufficient rapidity for all practical purposes. Lastly, the return of the heavy gun to battery is now accomplished by springs, as in the case of small guns, and thus the use of hydraulic or other power brought up by pipes or wires from below is no longer necessary.

To sum up, then, the advantages of so-called hand working of heavy guns are: 1st. That in the complete absence of all other power, caused by breaking of pipes, wires or motors, the operations of running out, hoisting ammunition, loading, training and elevating the guns can still be performed by hand, though the hoisting of ammunition and the training will be but slowly and laboriously accomplished. 2d. That there are many less pipes or wires and motors, with consequent less chance of disablement in action. With the old arrangements, not only would an injury to the power system anywhere absolutely prevent any further use of the guns, it being impossible to either run them out or to elevate them without power, but the numerous connections to the recoil cylinder and elevating ram greatly increased the chances of injury to some part of the power system.

The disadvantages of the hand-worked mounts are, 1st, the necessary increase of time required for all movements which are performed by hand, and 2d, the increase in size of port opening caused by the necessity of pivoting the system at its center of gravity.

It will be seen, therefore, that while hand-worked mounts for heavy guns have sufficient advantage to probably cause their increased use, yet their adoption is not a radical advance, and no great gain can result from their furthest possible development.

The next question to consider is to what extent powder and projectiles can be further improved.

The introduction of so-called smokeless powders into general use is now an assured though not a completed fact. Its results will be far-reaching and will enormously increase the efficiency of ordnance.

All the smokeless powders in present use are colloids, either of gun-cotton, of nitro-glycerine, or of a mixture of the two.

Nitro-glycerine and gun-cotton are the two most powerful explosives known; in other words, the potential energy of a given weight of these two substances is greater than that of the same weight of any other chemical compound of sufficient stability for practical use. If this potential energy be instantaneously converted into energy of motion, as when gun-cotton or nitro-glycerine is detonated, the resulting force is too great to be controlled, but by changing the physical state of the explosive —making it a colloid—we can cause it to burn progressively instead of detonating, and thus we can control its energy. In accomplishing this result, however, we have reached a limit only to be passed by the discovery of an entirely new order of explosives, such as is unknown to our chemistry. We have trained to our service the most powerful forces known, and further possibilities of advance are not apparent. To increase velocities beyond what they now commonly are with smokeless powders, namely, 2400 to 2600 foot-seconds, we must increase the weights of our powder charges and the lengths of our guns, and accept the attendant disadvantages. The gain from increased length of bore alone is small; that from increased capacity of chamber and increased length of bore is as great as you please, but is accompanied by many inconveniences and difficulties, while the gain from increased weight of charge alone is attained only at the cost of increased powder pressures with attendant erosion of bore and shortened life-time of gun. If we allow 20 tons per square inch maximum pressure, we can perhaps get 2800 foot-seconds instead of 2500 or 2600 with 15 to 16 tons, but the life-time of our guns will be greatly lessened by the change.

Assuming that we are unwilling to allow much higher pressures than at present, we have the following advantages from the use of smokeless powder:

(1) An increase in velocity of about 500 foot-seconds with consequent flatter trajectories and greater penetrating power.

(2) Absence of smoke, increasing the facility of manœuvring of the fleet, as well as that of aiming the gun.

(3) Reduced weight of powder charge, as well as absence of residue, facilitating loading.

While there is but one disadvantage—increased cost.

With the adoption of a reliable smokeless powder for service

use in all guns, then, we appear to have come near to the probable limit to the power of the gun, as well as near to the probable limit to rapidity of fire.

But have we yet reached the point where it can be said that we have a reliable smokeless powder? Evidently we have not such a powder in service use, and the most that can be said is that the goal is in sight.

The fact is that almost all the known varieties of smokeless powder are unreliable, deteriorating after a time and gradually decomposing, and it is the fear of the results of such decomposition, when large quantities of the powder are contained in closed tanks or cartridge cases, which has operated to prevent their general service use.

It is probable that the French, who were the first to develop a smokeless powder, are to-day the only nation having a perfectly reliable one. They have in service use in all their guns a pure gun-cotton colloid, and we are endeavoring to follow in their traces.

The English cordite, which contains 58 per cent. of nitro-glycerine, is commonly reported to be unreliable, though they have had sufficient confidence in it to issue it to the service.

The reason why we prefer to follow the French example is that we consider any powder containing nitro-glycerine unsafe. It is thought that in such a powder as cordite the nitro-glycerine is held in the colloid of gun-cotton as water is held in a sponge, and that pressure will cause the nitro-glycerine to exude, in which case even a slight shock will produce detonation. Moreover, it is thought to be impossible to make a really stable combination of heterogeneous nitro-substitution products; the interaction of the nitro-glycerine and gun-cotton and of the impurities in each will result, especially at high temperatures, in a slow decomposition and increasing instability. Gun-cotton, on the other hand, we know from many years of experience to remain unchanged through long periods of exposure to varying temperatures, provided it be kept wet. Now the form of a gun-cotton colloid protects its substance from the air much as water protects wet gun-cotton, and consequently there is every reason to suppose that it will remain unchanged if properly made. Again, the temperature of combustion of nitro-glycerine is much higher than that of gun-cotton (3469° C. to 2710° C.), and this

results in greatly increased erosion of the bore when nitroglycerine powders are used.

With regard to the common notion that with smokeless powders great length of bore is desirable—this is certainly not the case with gun-cotton powders; 50 pounds of gun-cotton will do about the same work as 100 pounds of powder, and its combustion will develop about one and one-half times the volume of gas at about the same temperature. Consequently, if used in the same gun in this proportion, the gun-cotton will evidently produce a much higher maximum pressure if it burns as rapidly as the powder, or, if made to burn more slowly, it will produce a much more sustained pressure. But when all the charge is consumed the pressure of the gun-cotton gases will fall off much more rapidly than will that of the powder gases, because out of the 100 pounds of powder are formed 56 pounds of solid or liquid residue, from which the 44 pounds of expanding gases extract heat which keeps up their pressure, while the 50 pounds of gas from the gun-cotton has no reserve heat to draw upon. In other words, with a gun-cotton powder the maximum pressure is carried further along the bore than with an ordinary powder, but when the gas ceases to be evolved the pressure falls more rapidly, and at the muzzle of a 40-caliber gun the pressure is less with the former than with the latter.

Turning our attention next to the projectile, let us regard this as the vehicle for the energy of the gun. By the use of smokeless powders we have greatly increased the amount of energy which the projectile conveys, and by the use of Harveyized armor we have greatly increased the amount of energy required to overcome resistance to perforation. The next step, and a most important one, is to so improve the projectile that it shall be able to deliver the whole energy of the gun in the form of work done on the armor plate. Neglecting the work lost in overcoming the resistance of the air in flight, the projectile of course delivers the whole energy of the gun at the point of impact, but the manner of distribution of that energy is all-important. If the projectile is strong enough to bear the impact unbroken and undistorted, then all its energy is usefully employed in perforating or cracking the plate; but just to the extent that it breaks or is distorted, its energy is dissipated in useless work upon itself. Now the A. P. projectile within a few

years had been developed to a point such that it was capable of withstanding the strains of impact against steel armor without injury to itself, and consequently it performed its function of a vehicle of energy perfectly, delivering the whole energy of the gun in the form of useful work on the plate. The successful introduction of the process of surface-hardening steel armor plates changed this completely. The projectile was no longer capable of withstanding the strains of impact against the hard-faced armor—it broke into fragments, and a very large percentage of its energy disappeared in useless work upon itself. In overcoming this defect a long step in advance will be taken, and in this direction real progress can still be made.

I hope within a short time to see the A. P. projectile again developed to a point close to that perfection which would consist in the delivery of the entire energy of the gun in the form of work on the plate, and when this happens I estimate that the value of our present armor will have been diminished about 20 per cent.

As far as common shell are concerned, in our own service we are abandoning the use of cast-iron and cast-steel shell, and propose to use only forged steel shell, the distinction between the armor-piercing and common shell consisting only in the fact that the latter has thinner walls than the former, with the resulting advantage of a much larger bursting charge and the compensating disadvantage that it will pierce less armor. It is a question whether it will not be advantageous to use armor-piercing shell only for guns of large caliber, 8-inch and above, and to use common shell only for the rapid-fire guns. With present practice it will be somewhat difficult to decide, in action, what sort of projectiles it is best to use.

Shrapnel, the third kind of projectile in use in the Navy, have a very limited use. They could be used effectively against exposed men in boats or on shore—also against torpedo-boats—but their efficiency depends entirely upon accurate time explosion, and that, under service conditions, is out of the question. I believe that the use of canister from the rapid-fire guns would serve a far better purpose than that of shrapnel under almost all circumstances, and I think that their issue in small numbers is very desirable.

None of the improvements in projectiles referred to are of

a radical nature, but there is one direction in which popular opinion believes an advance amounting to a revolution will some day be made. Many people think that the use of high explosive shell will revolutionize naval warfare, and that the adoption of such shell for service use only awaits the appearance of the great *American inventor* who will reveal the secret of how to use them safely. There is so much misconception on this subject that it seems worth while to consider it at some length. The danger in firing any explosive from a gun lies, of course, in the possibility of its going off in the gun and bursting the latter, and the greater the quantity of the explosive the more likely is it to go off and the more serious will be the effects of such an accident.

Whatever be the character of the gun, the explosive must be contained in some sort of a projectile, and that projectile must be given velocity by some sort of an accelerating force, be it the expansive force of compressed air or of powder gases, and the acceleration of the projectile at each instant must be a true measure of the force acting upon the projectile and upon the explosive contained in it. When the driving pressure on the base of the projectile is greatest, then is the acceleration of the projectile greatest, and then is the shock tending to explode it greatest. Nothing is gained by applying a small pressure at first and gradually increasing it; the maximum pressure on the base of the projectile, whether it occur before the projectile has had time to move or just as it reaches the muzzle of the gun, is what measures the danger of an explosion. Consequently, whatever form of gun is used for firing high explosive shell, the one requirement for safety is that the maximum pressure on the base of the projectile shall not be too great. It is just as safe to fire any high explosive shell from a powder gun as from an air gun, provided we limit the powder pressure to the pressure used in the air gun. This being understood, we have to consider the fact that the liability to explosion depends both upon the amount of explosive and upon its character. The column of explosive contained in the shell being driven forward with accelerated velocity, the greater the height of that column the greater the pressure upon its base, and if that pressure reaches a certain point an explosion will result. This is the reason why experiments with shell containing small amounts of high explosive have no value. Because a pound of nitro-

glycerine can be fired with high velocity from a gun, it by no means follows that 100 pounds can. The sensitiveness of nitro-glycerine to shock will prevent our ever using that on board ship, and although some other explosive compounds are slightly more powerful that gun-cotton, the safety of the latter, and our long experience with it, render it unlikely that we will adopt any other high explosive for service use. Now in the manufacture of gun-cotton we habitually apply a pressure of about three tons per square inch to the wet blocks, and we know this to be a safe pressure; consequently there is no danger in firing shell loaded with wet gun-cotton from powder guns provided we keep within this limit. This will allow us to safely fire about 175 pounds of wet gun-cotton in a 12-inch shell weighing 800 pounds at about 1600 foot-seconds muzzle velocity with our present 12-inch gun and powder. Such a shell, however, must necessarily have very thin walls, and there is no chance of its penetrating through even thin plates without breaking up. The wished-for destructive effect must be obtained, if at all, from detonation on impact. With a thick-walled shell containing only a small quantity of high explosive, it might be possible to delay detonation until the projectile had entered the ship, but the destructive effect of such a shell is no greater than that of a similar shell burst by gunpowder. In other words, the only possibility with the high explosive shell is to us as great a weight of explosive as can be safely thrown, and to provide means for its detonation on impact, and to trust to the effects of such a detonation outside the ship. How destructive these effects would be we do not know, but for my own part I believe they are greatly overestimated.

As to the means for detonating t ell on ,
really the most serious problem to wo d N
explosive can be really detonated with t
of mercury, and this is far more sensitive c
charge of the shell. Consequently, the r
firing the detonator, not in firing the main c
With wet gun-cotton, moreover, a dry in
needed as well as fulminate. However, t
solved, and as a result of actual tests, I feel c
can at any moment put on our ships shell r
cent. of their weight of gun-cotton and
fired at 1600 foot-seconds velocity and

There is absolutely nothing in the idea of special guns, air or other, being required for this; neither are any special forms of shell, cushioning devices and such, desirable or useful. The ordinary guns, with shell of ordinary form—only thin-walled so as to carry a large charge—and the ordinary powder charge, only reduced in weight, are all that we need or are likely to ever use, and, in my judgment, we could safely begin their use to-day if it were thought desirable to do so. But here is the rub. No one has entire confidence in the safety of such shell. The very idea that hundreds of shell, each charged with two hundred pounds of gun-cotton, are stored away in the magazines and must be brought up from below, loaded and fired in the heat of action, brings before the imagination such horrid pictures of the disastrous results of an accidental explosion in the gun, or anywhere inside the ship, that the mind refuses to be quieted by *ex cathedra* assurances that there is no danger. I have been present at numerous firing trials of high explosive shell, and I have been greatly impressed by the evident state of strain of the spectators, most of whom have been persons of long experience on the firing ground. These were all shell of comparatively small caliber, and I am convinced that the service use of large high explosive shell would produce a demoralizing effect upon both officers and men which would more than outweigh the possible increased destructive effect of such shell. Of course, this feeling of distrust would in time disappear if no accident occurred, and I only mention it as being a more potent reason for not putting high explosive shell on shipboard than is any difficulty in their actual manufacture and use.

As a natural sequence to the foregoing discussion of projectiles we now come to that of armor. In a paper which I had the honor to read here last year I argued for the continued use of armor, and pointed out its enormous advantages necessarily resulting from the fact that it effectually prevented the entrance into a ship of large capacity shell and of the multitude of projectiles delivered by the small rapid-fire guns. The first of these advantages is greatly reduced by the fact that the so-called armor-piercing shell are capable of being made truly so by the use of proper bursting charges; but even so, consider how much is gained if our armor will keep out all projectiles not of a caliber exceeding its thickness.

Very few large guns can be carried by even the largest ship,

and their rate of fire is slow. It is well worth while to pay the price for immunity from damage by the great number of small shell, even though we cannot escape the possibility of having our armor pierced by an occasional shell of large caliber.

Since the manufacture of armor was revolutionized by the discovery that face-hardening heavy steel plates was practicable, some further advance has been made by improvements in the methods of manufacture. It is found that a secondary forging of the plate, after carbonizing its face, but before tempering it, improves its resistance both to cracking and to perforation, and I think it can safely be said that we are now making the best armor in the world. Certainly all the tests abroad of which I have knowledge indicate the superiority of American to foreign made armor plate. Our nickel steel, carbonized, Harveyized, reforged plates are to-day equal in resistance to all steel plates, as made a few years ago, 60 per cent. thicker. That is, at present an 8-inch plate, when attacked by an 8-inch projectile of the best quality, requires for perforation a striking velocity of about 1900 foot-seconds, whereas the same projectile, with equal velocity, would have perforated a 13-inch steel plate. Last year I was of opinion that after our projectiles had been perfected this difference would nearly, if not quite, disappear, but further experience has convinced me to the contrary, and I now think that we cannot hope to reduce the lead of the face-hardened plate more than about 20 per cent., which would leave it finally about 30 per cent. better than the simple steel plate. This of course is a very great advance, and while partly due to other improvements, it is not at all an exaggeration to say that the successful introduction of the Harvey process has revolutionized armor manufacture.

With the best projectiles which we have to-day fired with the velocities given by smokeless powder, and striking normally at 2000 yards range, I estimate that complete protection will be given by our present armor plate if of the following thicknesses:

Against the	4-inch gun,	4-inch armor,
	5- "	5- "
	6- "	7- "
	8- "	10- "
	10- "	14- "
	12- "	17- "

Of course the chance of normal impact is very small, and it may fairly be said that armor one caliber thick, under service conditions, will give complete protection from any gun below the 10-inch, 12-inch armor from the 10-inch gun, and 15-inch armor from the 12-inch gun. As for the 13-inch gun, we must trust principally to the small chance of being hit for protection against its projectiles.

It may be interesting to hear a word about the capped projectiles which have given remarkable results in recent tests. It has been proven by numerous trials of shell with and without caps, that their use tends to prevent the projectile from being broken up on hard-faced armor, and consequently greatly increases its perforating power. This appears to be because the cap, made of very soft metal, not only supports the point, but also acts as a lubricant for it. Once through the hard surface and the rest of the plate is comparatively easy to penetrate. We are in hopes, however, to learn before long how to make projectiles which will do the same work without caps as present ones do with them, and as I have said before, this will be a most important step in advance.

As to the distribution of armor on our ships, we have made some recent improvements, such as raising the belt armor slightly and adopting elliptical balanced turrets. I think, however, we need to go further in the first direction, and as far as turrets are concerned, we need above all to increase their floor space. One of the greatest bars to rapid working of the turret guns of most of the ships we now have is the cramped space in which the guns' crews have to work.

I have reserved for my continuing paper to-morrow the important subject of the steps which have been, and still need to be, taken to improve the *accuracy of gun fire*, and now, in conclusion, I want to say that I hope you will not undertsand me to claim that our ordnance material is perfect, or even that it is not in many ways actually defective. What I do claim is that no part of it is so defective as to be incapable of a high state of efficiency in the hands of zealous and intelligent men; that what it chiefly lacks is in small details, which can and should be improved on board each ship, and that the skill born of frequent practice will bring it nearer to perfection than any probable improvements which can be made by its designers.

U. S. NAVAL INSTITUTE, ANNAPOLIS, MD.

ARMOR AND HEAVY ORDNANCE. RECENT DEVELOPMENTS AND STANDARDS.

By W. H. JAQUES.

(Read before Section G of the British Association.)

When I picked up the last issue of Brassey's Naval Annual (1896) and upon the title-page read—

> "No system of conduct, however correct in principle, can protect neutral powers from injury from any party. A defenseless position and a distinguished love of peace are the surest invitations to war."
>
> THOMAS JEFFERSON.

it occurred to me how little our legislators are influenced by the words of the eminent statesman which have been selected by the editor of a British annual of the record of the naval events of the year as a warning to Great Britain, the first naval power of the world, that its preparations for defense must be liberal and continuous.

The situation and policy of the United States could not be more accurately described than by these words of Jefferson, "*A defenseless position and a distinguished love of peace,*" yet little heed is given to his warning that these conditions "*are the surest invitations to war.*"

In fact, our engineers and manufacturers are the only ones who have awakened to the situation, and this awakening will no doubt be attributed to the hope of pecuniary gain. They have, however, no matter what the incentive, attained the highest standards in the production of armor, heavy ordnance and projectiles. All we need in the United States are adequate budgets and well planned shipbuilding programs. That we are gradually reaching out in the right direction is shown by the fol-

lowing table of estimates for 1896-7, taken from Brassey's Annual for 1896:

England	£21,823,000
France	10,637,096
Russia	6,440,666
United States	5,862,228
Germany	4,372,068
Italy	3,641,324

although in the table of effective fighting ships, built and building, the United States is left out, England, France, Russia, Italy and Germany only being included.

The progress in armor making referred to in my last public pamphlet (1894) has been continuous, and the United States (The Carnegie Steel Co., Ltd.) and Germany (Krupp) have produced armor fully 15 per cent., if not 20 per cent., better than the best *plain* steel Harveyed armor that Great Britain has placed upon her battle-ships; although one is handicapped in making thorough comparison so long as England continues to determine the value of her battle-ship armor by firing 6-inch soft Holtzer shells against 6-inch plates at velocities below 2000 ft. sec.

This comparison of superiority is based upon the Admiralty report of 1895-6, which states that—

> "During the year various experimental armor plates have been submitted by manufacturers for the purposes of test. None of these, however, have shown qualities equal to those possessed by the Harveyed steel armor mentioned in statement of last year."

Competition in the production of armor has become so active, the number of establishments for its manufacture so numerous, and the methods of its production and treatment, and its test, so complex, that it is not surprising there should be marked differences of opinion as to what kind and thickness of plate should be employed, and its distribution, and what caliber of ordnance should be used against it.

The most important tests that have been made in the past two years have taken place in the United States and Germany, and the results in these two countries have been so nearly identical that it became necessary for me to study very carefully the character of the projectiles employed. Since then, com-

parative trials of Wheeler-Sterling, Holtzer and Krupp projectiles have been made in three European countries, as well as in the United States. Although not so complete as I would wish, the results indicate that the Krupp projectiles employed in the tests of the German plates in question were somewhat inferior to those employed at the Indian Head (U. S.) trials. The German trials of 1894 and 1895 have been fully described in the British engineering journals, Brassey's Annual, and particularized by the pamphlets of Captain Castner, who reproduced, with comments, publications in *Stahl und Eisen*. French tests showing excellent results have been published in the French technical papers. With these you are all familiar.

In making a comparison of the tests I have cited we must not lose sight of the fact that the German and French plates were *experimental* and made to secure the greatest resistance possible, whereas those of the United States were *service* plates, representing hundreds of tons of armor, from which the inspectors had selected what they considered were the poorest of the lot.

A careful examination of the results of these trials leads us to conclude that to the products of the United States and Germany the first rank must be accorded, Great Britain and France being content to accept second place on the plea that as *plain* steel, carbonized, is so good it is not wise to pay the increased cost which the use of nickel entails.

Another very important test was made in the United States at the naval proving ground against a battle-ship turret (or rather a reproduction of one), the plate attacked being of carbonized nicket-steel armor, while its supporting plates, to complete the turret, were made of iron. While the results demonstrated that the 15-inch armor would undoubtedly keep out 12-inch projectiles with attacking service velocities and no injury to the vitals would result, the backward movement of the turret itself upon its supports was somewhat of a surprise; but it was estimated if the usual holding-down clips and roller flanges were employed they would be sufficient to enable the turret to keep its place on shipboard, even if attacked under similar conditions.

Examination of the published tests made in the various countries leads me to believe that British armor is considerably

inferior to the best *nickel*-steel *gas*-hardened plates now being used by the United States and Germany. If this be true, in matter of weight alone the better plates will effect a great saving, as these saved weights can be given to other elements requiring so much attention—such as ammunition, coal and other supplies, which are so exacting in the modern war-ship.

In my discussion of Dr. Elgar's important paper on the "Cost of War-ships," read before the Paris Meeting of the British Naval Architects, in June, 1895, I estimated there would be a saving of £64,000 in the item of armor alone for each of the first-class British battle-ships then under discussion if *nickel-steel*, carbonized, armor were substituted for the *plain steel*, Harveyized, which was to be used in their construction, even at the then comparatively high price of nickel. That this economy is not restricted to armor is endorsed by one of England's highest authorities, Mr. James Riley, who, at the April Meeting of the West of Scotland Iron and Steel Institute, in referring to nickel-steel, assured the shipbuilders and engineers present, that, by its use, "without any extra expenditure in construction, they could obtain 30 per cent. more efficiency out of their engines and boilers, effecting at the same time very considerable economy in the cost of fuel."

A summary of recent advances in the production of armor will include—the cheapening and more extensive use of nickel; the substitution of the hydraulic forging-press for hammers and rolls; better means of removing scale; simplification of the methods, and more uniform results, of super-carburization; utilization of the valuable sub-forging process (now required for all United States armor); improved facilities for hardening; and improvements in the machines and tools for shaping and finishing.

Mr. Schneider's success in making nick
a commercial product is perhaps the
and when we recall its already extensive en
guns, shafting, hammer and piston rods, tor d
building and bridge structures, and even ip a
if this development goes on in proportion to
past few years, *nickel-steel* must be given in
metallurgy as the Bessemer process, not
that England is still opposed to the

armor protection, employing it, uncarbonized, only for difficult shapes.

Public notices of the placing of five British battle-ships, to be known as the Canopus type, contain information that the most significant modification to secure a less displacement than that of the Majestic type will be a reduction of thickness of the Harveyized armor which protects the broadside. It is stated that the new ships will have 6-inch plating instead of 9-inch as on the Majestic. It will be interesting to know whether nickel is to be employed, or some new method of treatment other than that now used in England, to secure the increased resistance which this great reduction in thickness would indicate; for no one will believe that the Admiralty will be satisfied with less ballistic resistance than that of the armor of the Majestic.

All the best examples of the plates that have been tested, whether experimental or service, are those that contain nickel. This is equally true of the trials of Germany, France, Austria, Russia and the United States. The latest United States specifications require that all armor shall be of nickel-steel, supercarbonized previous to finished forging, after which it shall be reduced to final thickness by sub-forging.. This reworking and compression toughen the plate, decrease the tendency to brittleness and restore the fine grain of the metal, which becomes crystallized during the long period the plate is undergoing the carburization treatment and by reason of the high temperature employed. The sub-forging further has the effect of closing pipes, blow-holes and fissures that may have originally existed as minor defects and have developed into injurious ones during the process of carburization. In other words, the molecular structure, impaired or damaged by the cementation, is restored or repaired, the density is increased, crystallization broken up, elastic strength increased, and the product made tenacious, tough and hard.

The employment of chromium and tungsten in armor production has made some advance, principally in thin plates, and have been more used in France and Germany than elsewhere. There appears to have been very little done recently in the direction of manganese armor.

While in the United States the increased resistance of armor has determined the authorities to retain the higher calibers of

heavy ordnance, the Navy Department having ordered 13-in. B. L. rifles for battle-ships, and the War Department having commenced a type gun of 16-in. caliber (both adhering to the forged hooped type), Great Britain still keeps the 12-in. as her limit and continues the radical departure to wire construction made by Dr. Anderson, when he became Director-General, and so successfully carried out by him.

France adheres to types containing too many parts, and Germany it satisfied to possess a large number of guns of comparatively low ballistic power.

As a great deal has been written in the various countries upon the comparative efficiency and battery power of the new United States battle-ships with those of England and France, the following tables, published by the Iron Age from data prepared by the Navy Department, will be of interest for reference.

In the preparation of this information a unit of time is used as a basis of comparison, and a muzzle velocity of 2000 foot seconds has been taken, together with the following weights of projectiles:

Caliber.	Lbs.	Striking energy in foot tons per gun.	Same, per gun in one minute of time.
13-inch,	1100	30,470	5,078
12-inch,	850	23,545	3,924
8-inch,	250	6,925	2,308
6-inch,	100	2,770	6,925
5-inch,	50	1,385	9,002
4-inch,	33	914	7,797
6-pdr.,	6	166	1,826
1-pdr.,	1	28	420

Battery and Battery Energy in Foot Tons per Minute.

	Type					
	Heavy guns.		Large R. F. guns.	Small R. F. guns.		Total energy.
	4 12-in.	8 8-in.	6 4-in.	20 6-pdrs.	6 1-pdrs.	
Iowa,	15,696	18,464	46,782	36,520	2,526	119,988
	4 13-in.	8 8-in.	4 6-in.			
Indiana,	20,312	18,464	27,700	36,520	2,526	105,525
	4 13-in.	4 8-in.	14 5-in.			
Kearsarge,	20,312	9,232	126,028	36,520	2,526	194,618
	5 13-in.		14 6-in.			
Proposed,	20,312	....	96,950	36,520	2,526	156,308

The United States Navy Department's decision as to what constitutes the most efficient battery for its battle-ships is expressed in the following armament decided upon for the three proposed new battle-ships:

Main battery: 4 13-inch rifles, mounted in two turrets, fore and aft, and
14 6-inch rapid-fire in broadside.

Secondary battery: 16 6-pounders,
4 1-pounders, and
4 machine guns.

In his reference to experimental guns in the 1896 report to the Secretary of War, the Chief of Ordnance speaks favorably of the Crozier wire-wound gun, which has been built at the army factory under the direction of one of its officers, Captain Crozier. The report states that the gun (fired 210 times) has made an admirable record and that wire-wound guns constructed on this system can be made with sufficient endurance and stability, but that in structural stiffness it is somewhat inferior to the service type. That the system, however, is looked upon with some favor is shown in the insertion in the annual estimates of the Department of an item to authorize, at its discretion, the manufacture of a limited number of wire guns.

The marked success of Dr. Anderson's wire guns, built at Woolwich, demonstrates their value and practically endorses my oft-repeated statement that I like the type and believe it can be as efficiently, economically and quickly supplied as the built-up form. It is simply a question of selection—of fashion.

No matter which type—hooped or wire—is adhered to, improved armor and projectiles must be met by greater energies which involve higher pressures, shorter guns (for utility) and stronger material. That this last is to be obtained in the United States is evident from the following requisites in a 3-inch test piece for *nickel*-steel tubes for cannon of 8-inch caliber and over:

Tensile strength, 90,000 pounds per square inch.
Elastic limit, 56,000 pounds per square inch.
Elongation, 20 per cent.
Contraction of area, 40 per cent.

Equally favorable progress has been made with projectiles, but as yet very few truly competitive results are at hand. The uncertainty of their relative value still causes a very large unknown quantity in the valuation of armor comparisons.

In conclusion, we may count, at least in the United States, as commercial commodities, armor having 10 per cent. greater resistance than the best of last year; heavy ordnance giving *service* velocities of 200 ft. sec. higher; and armor-piercing projectiles that, to be accepted, must perforate a thickness of nickel-steel carburized armor equal to their caliber. Truly an excellent record.

PROFESSIONAL NOTES.

A GENERAL DESCRIPTION OF THE WHITEHEAD TORPEDO,*

WITH A BRIEF SUMMARY OF ITS PREPARATION, ON BOARD SHIP, FOR A RUN,

By W. J. SEARS, Lieutenant, U. S. Navy.

Weight of torpedo, ready for discharge.......	839 lbs.
Weight of wet gun-cotton (approximately)....	110 lbs.
Length of torpedo	11 ft. 8 in.
Greatest diameter (45 centimeters)	17.7.
Speed, (about)	28 knots.
Range	1000 yds.

THE WHITEHEAD TORPEDO is built chiefly of steel, and is nearly in the shape of a porpoise. It has a blunt, phosphor-bronze head, and is made in five sections, but dismounted and assembled in three parts. Its motive power is compressed air; it is propelled by two two-bladed screws, revolving about the same axis, in opposite directions, in order to neutralize their individual tendencies to produce lateral deviation. The after propeller is keyed to the main shaft, and the forward propeller to a sleeve or hollow shaft, free to move on the main shaft; by means of bevel gears on the main shaft, and on the forward end of the sleeve, suitably arranged, the propellers revolve in opposite directions.

The torpedo is maintained at constant depth by horizontal rudders, and on a straight course by vertical vanes set at an angle predetermined by experiment. The new models are great improvements on the earlier type in the matter of speed and certainty of work.

THE WAR HEAD, of sheet phosphor-bronze, is charged with approximately 110 pounds of wet gun-cotton, and is closed at its base by a bronze bulkhead. In the bulkhead is a moisture tap, through which distilled water may be poured when necessary to make up possible loss of weight by evaporation.

Soldered in the forward end of the war head is the primer case of brass, in which is inserted the dry gun-cotton primer.

The wet gun-cotton is inserted in a series of disks, a sufficient number of them, counting from forward, being pierced through their centers to receive the primer.

The primer consists of a series of small cylinders of dry gun-cotton in a metal case. The forward cylinder is pierced to receive the detonating primer, containing fulminate of mercury and capped with a percussion cap.

* The article will be more readily understood by reference to the plates in the book issued by the Bureau of Ordnance, or to the torpedo itself.

THE EXERCISE HEAD, of steel, is ballasted for exercise by filling it with fresh water.

THE WAR NOSE screws into the forward end of the primer case. A traveling sleeve has a thread cut inside, throughout its length, and in this thread works a traveling nut. The nut is turned by a screw fan receiving its motion by its passage through the water. The nut is screwed back by the action of the fan until it rests against the firing pin. A shearing pin holds the latter in place, and as the nut continues to revolve, the sleeve moves out, carrying the fan with it, until the square shaft of the fan is pushed out clear of the nut. The fan then revolves freely. When the torpedo strikes the target the fan, nut and sleeve are driven in, shearing the shearing pin and driving the firing pin against the percussion cap.

IMMERSION CHAMBER.—This chamber contains the immersion regulators. It is just abaft the air flask and is riveted and soldered to it. The after end is closed by a bronze bulkhead.

The purpose of the mechanism in this chamber is to control the horizontal rudders, after launching, so as to bring the torpedo to a predetermined immersion and keep it there during its flight. This is accomplished as follows:

A small compartment in rear of the immersion chamber has free communication with the water outside through several apertures in its walls. The pressure of water, due to depth below the surface, acts against a piston; but the water is prevented from getting behind the piston by an annular diaphragm of thin rubber. The motion of this piston, due to different pressures at varying depths, is communicated to the horizontal rudders by means of rods in such a manner that when the torpedo is below its plane of immersion the increased pressure will elevate the rudders, and when it is above the decreased pressure will depress them.

When the torpedo is in its plane of immersion the piston is kept in mid-position by an equilibrium between the pressure of the water and the tension of a spiral compression spring.

PENDULUM.—A pendulum, which swings in a vertical plane passing through the axis of the torpedo, acts to maintain the torpedo in a horizontal plane. If the hydraulic piston is acting on the rudder to steer the torpedo up or down, when the torpedo has inclined 3 degrees above or below the horizontal plane, the pendulum swings towards the end of the torpedo that is lowest and counteracts the action of the piston on the rudder. The combined action of the piston and pendulum is transmitted by a system of lever and connecting rods to the steering engine, and thence to the rudder, to maintain the torpedo in the horizontal plane at the set depth.

THE AIR FLASK is a hollow, forged steel cylinder, slightly tapered at the ends, with dome-shaped heads screwed and soldered in each end. A strengthening band, left on the inside surface in boring, is tapped from the outside for three screws for attaching the guide stud. Over a hole in the after head is bolted and soldered the body of the charging and stop valves.

ENGINE ROOM.—Next abaft the immersion chamber comes the after body, containing two compartments; between them is a bulkhead. The joint is made tight by a rubber gasket. To this bulkhead the propelling machinery is secured. The engine room contains the main engine and oil cup, the valve group, the sinking and retarding gear, the steering engine, and the locking gear.

THE WHITEHEAD TORPEDO ENGINE consists of three cylinders, fixed radially about the propeller shaft, with their axes 120 degrees apart. Within the circular enclosure at the junction of the cylinders the main crank is free to revolve, and receives its impulse from the piston of each cylinder in succession. The compressed air is admitted behind the piston and evacuated in proper order by means of three slide valves, each working in a separate chest, on the forward face of each cylinder; but all regulated by a single cam, keyed to the main shaft.

THE DEPTH INDEX.—The head of a spindle is accessible from the outside of the shell, which, when turned by a socket wrench, compresses the spring acting against the hydrostatic piston, and thus increases the resulting immersion of the torpedo. Graduations on the index sleeve show the number of turns to give the socket wrench for the desired immersion. The depth index is then clamped by screwing down a clamping nut.

THE STEERING ENGINE is operated by air at the working pressure of the main engine, and transmits the action of the immersion mechanism to the rudder.

The combined action of the pendulum and hydrostatic piston is transmitted by a rod to the steering engine valve, which controls the action of the steering engine, and thence the position of the horizontal rudder.

The forward end of the valve rod screws in a union which connects it with the rod from the immersion mechanism.

Rigidly attached to the valve rod is a star wheel with six points, called the valve star.

Turning the valve star shortens or lengthens the valve rod, thus limiting the rudder movements.

It is usually set to give four divisions of down-rudder and three of up-rudder. The divisions are marked on the top blade of the tail of the torpedo.

The forward end of the steering rod acts against a spiral spring. When, at the end of the run, air is cut off from the steering engine this spring forces the steering rod forward, puts the rudder up, and brings the torpedo to the surface.

THE REDUCING VALVE is balanced between the pressure of a spring tending to raise it from its seat and the pressure of air on top of it tending to seat it. The object is to regulate the pressure of air admitted to the engine. A crank is used to screw down a plug which compresses the spring. The number of turns to be given this regulator plug for different speeds is given in a table.

THE STARTING LEVER admits air to the reducing valve, from whence it passes to the main engine. Before the torpedo is launched the lever lies flat along the upper surface of the shell, the end pointing forward. When the torpedo is launched the starting lever catches under a tripping latch, in the tube, and is thrown back.

THE DISTANCE GEAR provides means for automatically closing the reducing valve, and thus stopping the engines, after the torpedo has run a predetermined distance.

In general terms the action of the distance gear may be described as follows: A spindle, with a square head, is accessible from the outside of the torpedo, through a hole, and may be turned by a socket wrench. The spindle has a worm on its lower end, which engages the teeth of a wheel, with cogs around a portion of its circumference, called a distance sector. One turn of the spindle revolves the sector one tooth, and the number of turns for any distance is given in the table furnished.

The distance sector having been set for any distance, when the torpedo is set in motion the sector is revolved in the opposite direction to that in which it was turned in setting by suitable connections with the main shaft. When the sector has revolved back to the proper position it releases the tension on the spring of the reducing valve, which closes, and shuts off the air from the main engine.

RETARDING GEAR.—The object of this gear is to retard the admission of air to the engine from the instant of launching until the torpedo enters the water, thus preventing undue racing of the engine. A lever, called the retarding lever, is so arranged that when it is in a certain position (its after position) it will allow the reducing valve to open only slightly, thus throttling down the main engine. This lever is operated by a bell crank lever, to which is riveted a thin plate of steel, called the water tripper. When not in operation the water tripper lies flat along the surface of the torpedo. Before the torpedo is launched the water tripper is raised to a vertical position. When the torpedo is launched its rush through the water throws the water tripper down flat and releases the reducing valve to its full action.

SINKING GEAR is provided for use in action for the purpose of sinking the torpedo at the end of an unsuccessful run. It is advisable, however, to remove one of the drain plugs in the after body (which will accomplish the same result) instead of using the sinking gear.

LOCKING GEAR.—When the torpedo is launched the inertia of the pendulum causes it to lag to the rear, thus causing the torpedo to make a deep initial dive. To prevent this, locking gear is provided, which locks the steering engine valve rod until the pendulum will act independently of its inertia. The locking gear is attached to the after face of the immersion bulkhead, and the locking is accomplished by inserting a stiff rod through a hole in the top of the shell and forcing down a ratchet bar, which, acting through an arrangement of levers, locks the valve rod of the steering engine. A small pinion, by the engagement of its teeth with the teeth of the ratchet bar, holds the latter down against the tension of the spring.

This pinion receives a motion of rotation from the main engine, and thus gradually releases the ratchet bar, which in turn releases the valve rod of the steering engine.

The position in which the rudder is locked up, down, or horizontal, is regulated by a locking star. This position is determined by trial before entering the torpedo in the tube, the propellers being locked with the yoke, and the starting lever then thrown back for an instant.

THE TAIL of the torpedo consists of the part abaft the after body, comprising the gear box, the tail tube, and the frame of the tail. The latter consists of a forward and after cone, each carrying a pair of vertical flat blades and a pair of horizontal ones. The forward and after blades are joined stiffly together by rails. On the upper edge of the top rail is a guide which enters the guide slot in the tube in launching.

The gear box carries the bevel gears by which the motion of the main shaft is transmitted to the outer tubular shaft in a contrary direction.

The propellers, of steel, are two-bladed and are carried in tandem, the forward one, right handed, on the outer tubular shaft, and the after one, left handed, on the main shaft.

The rudder, of steel, is carried at the rear end of the tail, and is connected with the steering engine rod by a series of levers carried around the propellers on one of the vertical flat blades. Its motion is limited by a wedge.

The vertical vanes are set when the torpedo has its trial. They are pivoted at their forward ends, and can be swung on their pivots, to starboard or port, to give permanent rudder effect.

PREPARATION, ON BOARD SHIP, OF THE WHITEHEAD TORPEDO FOR A RUN.

Start air pumps, to charge accumulators.

Put yoke on propellers.

Close starting lever.

Enter head of torpedo in tube.

Put rope sling under after body, raise it from truck, at same time elevating breech of tube, as necessary, for torpedo to clear truck.

Place loading staff against end of propeller shaft and shove torpedo into tube, with guide stud just entering guide slot.

Remove charging valve plug.

Screw in valve end of charging pipe.

Open stop valve.

Open valves in air pipe between separator and torpedo.

Examine torpedo for leaks.

TRY STEERING ENGINE.—To do this admit air to steering engine by lifting the starting lever slightly. Insert a small rod through hole in shell of torpedo, place its end between the valve star and locking jaws, and move the steering valve rod as far forward, and then as far aft, as possible. This should give four divisions down rudder and three up rudder.

SET DISTANCE GEAR by means of socket wrench, inserted through a hole in the engine-room door, fitting over the square upper end of the adjusting spindle. The adjustment card gives the setting for 400 and 800 yards range.

See that the friction cam pin bears against the distance sector stud.

SET THE REGULATOR.—Insert the crank, with a square head, in the square socket of the head of the regulator plug. Screw the plug up until its upper face is flush with the top of the regulator body. The adjustment card gives the number of turns to be given to the plug to obtain maximum speed for a 400 or 800 yard run.

ADJUST THE LOCKING STAR.—The locking star is to maintain the rudder up, down, or horizontal while the rudder valve is locked. The adjustment is made with a rod, or screw-driver, inserted through a hole in the shell, on the side of the torpedo, the end pressing against one of the points of the star. Turning the star to the right (looking towards the head of the torpedo) moves the locking jaws aft and puts the rudder down; turning it to the left puts the rudder up.

ADJUST THE VALVE STAR.—The valve star is to set the valve of the steering engine, and thus control the throw of the rudder. This is done by turning the star, which practically shortens or lengthens the valve rod. The star is turned by inserting a rod or screw-driver through a hole in the shell, the end pressing against one of the points of the star. Turning towards the right (looking towards the head of the torpedo) shortens the valve rod and puts the rudder down; turning to the left puts the rudder up. A scale of divisions is marked on the top blade of the tail. When the valve is moved its full throw, the rudder movement is four divisions down and three up. The adjustment card gives the adjustment for the valve star.

SET THE RATCHET BAR.—Lock the steering engine valve rod by pushing down the ratchet bar with a stiff rod inserted through a hole in the

top of the shell of the torpedo. The number of teeth to engage for any distance is given on the adjustment card up to 13 teeth, the total number, which corresponds to a run of 100 yards.

Lift the starting lever slightly and test locking. Lower starting lever.

WHY LOCKED.—The steering engine valve rod is locked to prevent the rudder acting while the torpedo is gathering its headway. The inertia of the pendulum causes it to lag to the rear, which would put the rudder down and cause a deep initial dive. The valve rod is, therefore, locked until the pendulum will work independently of its inertia, when it is automatically released.

If it is desired to set the ratchet bar for any distance corresponding to the interval between any two teeth, insert a socket wrench through a hole in the bottom of the shell and turn the square-headed stop-screw. This is an adjustment seldom made.

VERTICAL VANES.—See that the vertical vanes are set according to the adjustment card.

DEPTH INDEX.—Put the socket wrench on the head of the spindle and screw it down until set to the depth (in feet) shown by graduation on the index sleeve. These are stamped on the sleeve for 5, 10, 15, and 20 feet. The depth index is put in place with the mark 5 corresponding with the fore and aft line. Starting from this point, adjust to any greater depth for the torpedo to run by turning the spindle of the depth index until the mark on the index sleeve comes to the fore and aft line; then set up the clamp nut.

OIL CUPS.—Fill valve group oil cup, gear box oil cup, engine-room oil cup, and oil after bearing. The oil in the valve group oil cup is for packing, and is forced out by pressure of air.

See all drain plugs in the after body closed.

Close valves in charging pipe; unscrew charging pipe, and screw in plug.

Lift firing lever and put in safety pin.

Lift water tripper.

Raise tripping latch and shove torpedo in tube.

Take off yoke and see propellers turned until notch on end of shaft is S.S.E. (This is to prevent engine being on center, as the cylinders cut off at 1/3 stroke.)

Work firing lever up and down, to see that stop pin is not jammed.

Close door of tube; load, prime, point, and fire.

THE UNITED STATES BATTLE-SHIPS ALABAMA AND CLASS.

[Reprinted from IRON AGE, Nov. 26, 1896.]

From a paper on the new battle-ships, read by Chief Constructor Philip Hichborn, U. S. N., at the recent meeting of the Society of Naval Architects and Marine Engineers, we take the following:

DRAFT.

In the paper presented to the society at its last meeting I mentioned some of the limitations and restrictions imposed upon those responsible for the designs of our war vessels, and it will be remembered that one of e principal difficulties enumerated was that due to the shallowness of

our harbors. The absolute limitation in draft imposed by this condition greatly complicates the design when so many other elements have to be taken into consideration; but the success attained in this direction is believed to be quite satisfactory, since the draft of the new battle-ships is only 23 feet 6 inches at their normal displacement, with all outfit, and two-thirds supply of stores, ammunition, etc., on board and 800 tons of coal in the bunkers.

SPEED.

As in all recent designs of battle-ships for the United States Navy, a moderate speed only has been attempted, as it has generally been held in this country that the high speeds aimed at by some foreign navies were not desirable in battle-ships when obtained by sacrificing other and more essential qualities. For this reason the designed speed of our recent battle-ships is more than a knot less than that required for some new foreign designs; but this speed is still much greater than will ever be employed in fleet tactics, or the actual operations of war; in fact, the highest speed heretofore adopted in fleet tactics with battle-ships has rarely exceeded 12 knots. Moreover, the speed developed by our vessels during their contract trials is maintained steadily for four hours and is not a mere measured mile record, thus affording a very accurate measure of the endurance which might be expected in actual service—a test which the measured mile record of certain foreign services does not afford.

FRAMING, SPECIAL FEATURES, ETC.

The framing of these new battle-ships is slightly different from that hitherto in vogue in vessels of this class in our service. The main frames are continuous from the keel to the armor shelf, and again from the armor shelf to the upper deck. The longitudinals are of course continuous, their lower edges being scored over the main frame angles and the lower angles of longitudinals being worked intercostally. The upper angles of longitudinals are, however, continuous, while the reverse bars are worked intercostally. Between the frame angles and reverse bars are worked bracket plates of uniform width, flanged at one end so as to connect with the longitudinal, and also flanged at the other end to give local stiffness. In this manner great rigidity is given to the floors of the vessel and there is less liability to damage in grounding or docking; at the same time this flanged floor plate provides greater strength of structure with the expenditure of less weight.

Docking keels are also provided, the extremities of these keels terminating at the athwartship planes passing through centers of 13-inch turrets, the bottom surface of the docking keels and the middle line keel of the ship being in the same horizontal plane.

ARRANGEMENT OF BOILERS AND COAL BUNKERS.

In the arrangement of coal bunkers special care has been taken to provide easy stowage and accessibility for firing, at the same time affording good coal protection for the boilers. There are athwartship bunkers at each end of the boiler space, and large longitudinal bunkers at the sides, all of these bunkers opening directly into the fire-rooms. A distinct departure from former practice in our service has been made in the arrangement of boilers, which, instead of being placed fore and aft, are placed athwartships, with the furnace doors and fire-rooms on the outboard side. This affords excellent facilities for firing and also provides easy communication between the fire-rooms.

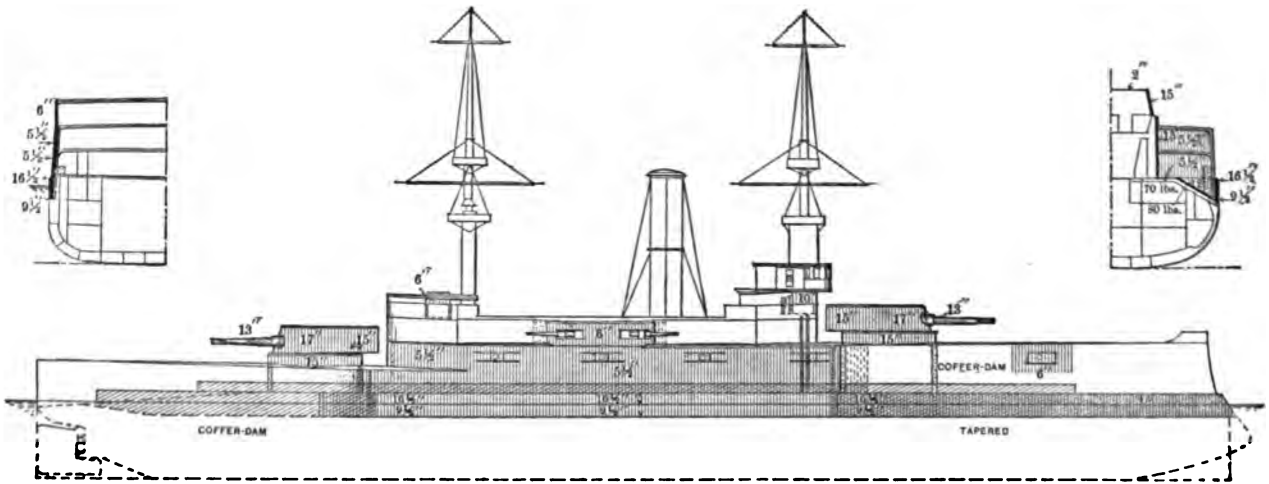


Fig. 1.—Side Elevation, Showing Armor and Armament.

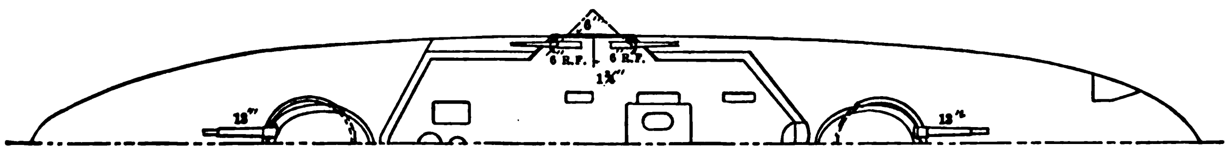
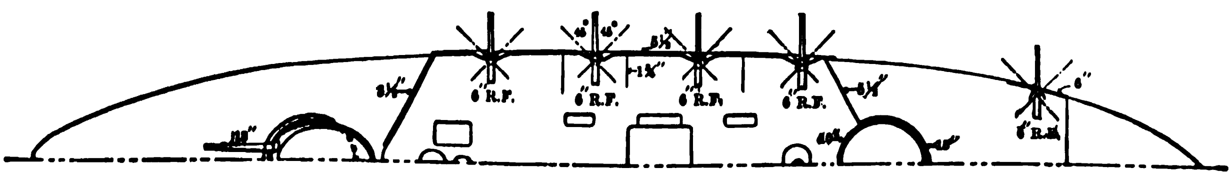


Fig. 2.—Half Plan.



HULL PROTECTION.

The hull is protected against injury at the water-line region by heavy tapered armor of a maximum thickness of 16½ inches, and extending from 3 feet 6 inches above to 4 feet below the normal load water-line. The maximum thickness is maintained for the entire length of the engine and boiler spaces. Figs. 1 to 4. From the forward athwartship coal bunker bulkhead the thickness is gradually reduced until it reaches 4 inches, which thickness is maintained to the bow. At the top of the belt, for the length of engine and boiler spaces, a flat protective deck 2¾ inches in thickness, worked in three layers, extends from side to side of vessel, being tap riveted to upper edge of side armor. Forward of the machinery space, however, the protective deck is turned down or inclined to the armor shelf level. Thus, any projectile passing through the vertical armor would, even if it were not broken up or deflected in its passage, have to encounter a sloping deck 3 inches in thickness. Abaft the heavy armor belt the protective deck is worked in a similar manner to that described for the forward end of the ship, except that the slope plating is increased to 4 inches in thickness in order to afford greater protection to the steering gear. Where the protective deck is inclined at the sides, as above described, coffer dams 3 feet in width and extending to the top of armor belt are provided, and are to be packed with corn pith cellulose, compressed to a density of 6 pounds per cubic foot.

To provide as far as possible against the serious damage to the boilers and engines due to a raking fire from forward or aft, the opening between the flat deck and the sloping sides is, at each end of the machinery space, closed by diagonal armor bulkheads 12 inches in thickness.

From the top of the thick belt, extending to the main deck, the hull is further protected by a belt of light armor 5½ inches in thickness; this armor extends from barbette to barbette, ending in diagonal bulkheads

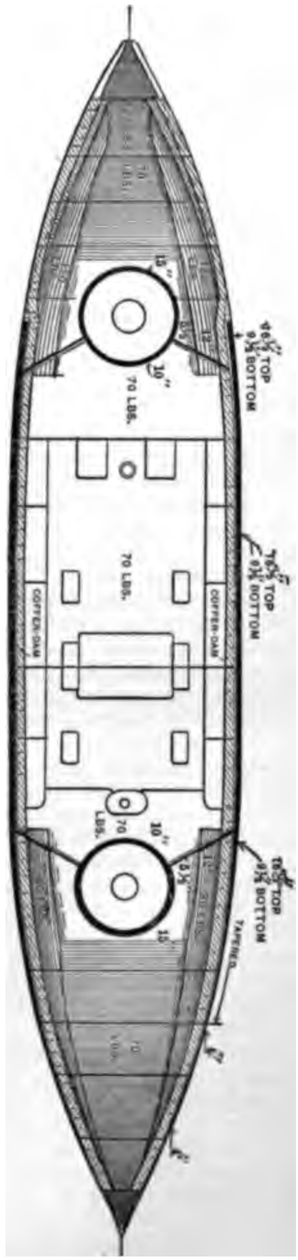


Fig. 4.—Plan Showing Armor.

in line with the 12-inch bulkheads below. Within the limits of this belt the broadside torpedo tubes are placed. Inboard of this 5½-inch armor, and extending well forward and aft, as shown on plans, are worked coffer dams 3 feet in width and 3 feet high, the top of the coffer dams being 6½ feet above the load water-line. These coffer dams are also filled with corn pith cellulose packed to the same density as those on the protective deck.

The side of ship between main and upper decks, and from forward barbette to a point just forward of the after turret, is protected by 5½-inch armor, with diagonal armor terminations, the forward one being worked immediately over the diagonal bulkhead of the deck beneath. Within this light redoubt are placed eight of the 6-inch rapid-fire guns. Thus the central portion of the vessel is completely inclosed by a continuous wall of armor extending from 4 feet below the load water-line to the level of the upper deck, a distance of about 23 feet, and the walls of this redoubt are in no place less than 5½ inches in thickness.

In addition to this very complete protection of the greater part of the 6-inch rapid-fire gun battery against the entry of smaller projectiles, the guns' crews are still further protected by 1½-inch splinter bulkheads worked between each pair of 6-inch guns, thus minimizing the effect of exploding shells, even though they should enter the armored redoubt.

The other 6-inch gun positions, on the gun deck forward and on the upper deck amidships, are protected by armor 6 inches in thickness, that on the upper deck being turned in at the ends so as to afford protection against raking fire.

The conning tower, situated as shown on the drawings, is protected by armor 10 inches in thickness, being connected with a central station below the protected deck by a tube, the walls of which are 7 inches thick.

In addition to the conning tower forward, these vessels are provided with an armored signal tower at the after end of the superstructure deck, the walls of this tower being 6 inches in thickness.

THE BATTERY AND ITS PROTECTION.

In the character and arrangement of the battery of the Alabama class decided changes have been made from the designs of former ships of this type in our service. In the first place, the 8-inch battery has been entirely abandoned, and the calibers of the heavier guns reduced to two, viz., 13-inch and 6-inch guns. This departure was made upon the recommendation of a special board which was ordered to report upon the whole question of battery arrangement, etc., the ground taken by the board being that the use of an intermediate caliber, such as the 8-inch gun, was unnecessary, and complicated the arrangements for ammunition supply.

Of course many arguments may be advanced for as well as against the findings of the board, but the arrangement adopted in the Alabama class is in line with recent foreign practice and will undoubtedly give good results.

The main battery will consist of four 13-inch guns, mounted in pairs in turrets forward and aft on the midship line, and protected by armor 15 inches in thickness, with port plates 17 inches thick. The ammunition hoists and revolving gear of turrets are protected by barbettes 15 inches thick, except over the arc within the diagonal armor, where the barbette is reduced to a thickness of 10 inches, to save weight.

The turrets are oval in shape, with the front plates slightly inclined and the rear plates vertical, in order to give ample room for the handling of the guns and their loading appliances. The center of gravity of the revolving parts is in the axis of rotation, so that the turret is balanced and can thus be turned by its engine without serious retardation, even when the ship has a heavy list. The forward turret is at the level of the forecastle deck, the axis of the guns being 26 feet 6 inches above the normal load water-line; the after turret is on the main deck, the axis of the guns being 19 feet above the normal load water-line. Each pair of guns sweeps an arc of 135 degrees from the midship line.

Three sighting hoods are provided for each turret, the one in the middle being for the turret turner, whose sole duty is to keep the guns pointed at the target, as far as their lateral direction is concerned. The hoods on each side are for the gun pointers.

Between these 13-inch gun emplacements, and within the armored casemate previously described, are eight 6-inch rapid fire guns in broadside. These guns are capable of a total arc of train of 90 degrees and are protected by 3-inch shields supported on the carriage and the 5½-inch armor of the casemate. Each gun is separated from its neighbor by 1½-inch steel splinter bulkheads. Four more 6-inch rapid-fire guns—two on each side—are mounted on the upper deck, above this casemate; they are protected by 6 inches of armor, and are capable of firing fore and aft. On the gun deck forward is another pair of 6-inch guns protected by an armor plate 6 inches thick.

The auxiliary battery consists of seventeen 6-pounders and six 1-pounder guns, mounted where practicable to obtain good command and yet be clear of the blast from, and interference with, the rest of the battery. Four broadside torpedo tubes, situated as shown on plans and protected by 5½ inches of armor, complete the armament of these vessels.

The following table gives the weight of fire of one discharge (neglecting the auxiliary battery) from all the guns available on the bearings given, and affords an interesting comparison of the relative weights of fire of these vessels as compared with the Kentucky, Iowa and Indiana classes. There is also given a table showing the complete batteries for the same vessels.

Table of Weight of Battery Fire for First-class Battle-ships of the United States Navy.

	Ahead or astern. Pounds.	Bow to quarter. Pounds.
Alabama class	2400	5100
Kentucky class	2700	5750
Iowa	2766	4499
Indiana	3400	5600

HULL.

Length on load water-line	368 feet.	
Length over all	373 feet 9	inches.
Breadth molded	72 feet.	
Breadth extreme	72 feet 2½	inches.
Freeboard forward	20 feet.	
Freeboard aft	13 feet 3	inches.
Freeboard amidships	19 feet 10	inches.
Mean draft (with 800 tons coal and two-thirds stores and two-thirds ammunition)	23 feet 6	inches.

Corresponding displacement	11,520 tons
Speed per hour, in knots	16.
I. H. P.	10,000.
Mean draft (with all stores, provisions and ammun'n and 1200 tons of coal on board)	24 feet 7 inches.
Corresponding displacement	12,140 tons.

ARMAMENT.

Main battery	4 13-inch B. L. R. 14 6-inch R. F. G.
Secondary battery	17 6-pdr. R. F. 6 1-pdr. R. F. 4 Gatlings. 1 field gun.

ARMOR.

Material: Harveyed nickel steel.

Water-line belt, thickness amidships: Top	$16\frac{1}{2}$ inches.
Water-line belt, thickness amidships: Bottom	$9\frac{1}{2}$ inches.
Height of upper edge above normal load line	3 feet 6 inches.
Total depth of belt	7 feet 6 inches.
Side armor above main belt, thickness	$5\frac{1}{2}$ inches
Superstructure armor, thickness	$5\frac{1}{2}$ inches
Turret armor (13-inch guns), thickness	17 and 15 inches.
Barbette armor, thickness	15 and 10 inches.
Protective deck armor, thickness	$2\frac{3}{4}$ to 4 inches.
Conning tower armor, thickness	10 inches.

MACHINERY.

The main propelling engines will be of the vertical, inverted cylinder, direct-acting, triple-expansion type, and will be placed in two water-tight compartments separated by a middle-line bulkhead.

Collective I. H. P. of propelling air pump and circulating pump engines	10,000.
Number of revolutions for above I. H. P.	120.
Diameter high-pressure cylinder	$33\frac{1}{2}$ inches.
Diameter intermediate cylinder	51 inches.
Diameter low pressure cylinder	78 inches.
Length of stroke	48 inches.
Cooling surface of main condensers	7,000 square feet.
Cooling surface auxiliary condenser	800 square feet.

There will be eight single ended steel boilers of the horizontal return fire tube type, placed in four water-tight compartments.

Dimensions of boilers: Length	9 feet $11\frac{1}{4}$ inches.
Dimensions of boilers: Diameter	15 feet $6\frac{1}{2}$ inches.
Working pressure (pounds per square inch)	180
Total heating surface of all boilers	21,200 square feet.
Total grate surface	685 square feet.
Number of furnace flues	4
Diameter of flues	39 inches.

CRUISERS WITH RAMS.

[ENGINEERING.]

Although there is much difference of opinion as to the tactical advantages of the ram in warfare, there is none as to the possibility of conditions arising where it would be of effective use, and it is interesting to note that in the design of a class of cruisers now being completed in the Dockyards, special attention has been devoted to the strengthening of the ship forward, so that they may use their ram without the least fear of serious damage resulting to their structure. These vessels are known as fleet cruisers, and one of them—the Furious—is to be launched to-day (Dec. 3) at Devonport; a second—the Gladiator—we believe will be floated on Dec. 8, at Portsmouth. The Vindictive is building at Chatham, and the fourth—the Arrogant—is being completed at Devonport. It is important, however, to note that they are as effectively armed as ordinary cruisers, and thus one serious objection to special ram ships is removed. Hitherto armament has been made a secondary consideration in such vessels. After the demonstration of the effective use of the ram in the American war and at Lissa, we, in common with some other nations, built light ships with powerful rams, and with one, or at most a couple of guns, mounted in a forward turret. The old Hotspur and Rupert represent this stage in the evolution of the class. In the succeeding ships, the Hero and Conqueror, heavier guns, and a turret with weapons for stern fire, were fitted, with larger engine power. Later, as a result of the agitation headed by Admiral Sir George Sartorius, the Polyphemus was built, her only function being to ram, and thus her armament consisted of light guns to ward off torpedo attack. The absence of guns was regarded by some as a satisfactory feature, since their smoke might have affected the steering towards the enemy to be rammed. The officer fighting the ship, however, could have silenced his guns and freed his course of smoke at the crucial moment; but even if the objection were well founded, it is removed by the use now of smokeless powder; and a cruiser, primarily designed for ramming, should also have heavy bow fire.

The cases of ramming have not yielded much instruction except in one point, and that seems to be that the ship ramming is as likely to be injured, although perhaps not so disastrously, as the one rammed. This is especially so when both are manœuvred, a circumstance proved in the case of the Camperdown-Victoria collision in June, 1893; while at Lissa there is the case of the Kaiser being more injured than the Portogalla which she rammed, so that Sir William White, the Director of Naval Construction, in the new ram cruisers has done well in meeting this objection, for, as shown in the sinking of the old Vanguard, of the Grosser Kurfurst, of the Cumberland in the American war, and of the Huascar in the Chili-Peruvian war, ramming can be effective, and it is necessary to specially provide for it. In the Furious and the other vessels of the class, the stem is massive and well braced to the interior structure, the framing is heavy, the shell plating is 1 in. thick, and over this there is nickel steel armor plating 2½ in. thick, extending for a very considerable distance aft, although with decreasing depth. At the stem it is the full depth of the ship, but the top edge curves downwards and the bottom edge upwards, so that the belt continues at the water line for a distance of quite 50 ft. from the ram.

Another necessity is quick manœuvring. The most effective cases of ramming in warfare, that of the Huascar and Cumberland, for instance,

were when the enemy was at anchor. That, however, is a contingency not to be depended upon, and two opposing ships may have the same desire to ram. Effective speed and manœuvring will greatly assist calm judgment in such a case, and everything that wide experience can do has been done in the Furious class. There are two rudders, one forward, the other abaft, the twin propellers. The deadwood is cut away: in other words, the flat plate keel slopes upward, giving the propellers a clear sea in which to work. The after rudder is of the usual balanced type and worked in the ordinary way, the bottom of the rudder, like the propeller brackets, being supported on framing. The small auxiliary rudder forward is of the same type. It is worked by worm gearing from the same head as the main rudder. The speed, an important element also, is to be 19 knots, and the dimensions of the ship have been minimized to improve the manœuvring qualities. They are the shortest cruisers for their size in what may be termed the modern Navy, for although of 5800 tons displacement they are only 320 ft. long by 57 ft. 6 in. beam, and their mean draft is 21 ft.

A strong feature, as we have already suggested, is the weight of bow fire. On the forecastle there is to be mounted in a central position a 6-in. quick-firing gun, protected by a 3-in. shield, while a little further aft on either side is a gun of the same calibre, similarly protected. These guns fire in line with the keel and 30 deg. abaft the beam, and as the forecastle deck is formed with what is known in the merchant service as a turtle back, the possible depression of these guns will be greater than with ordinary ships. An indent is made so that the top of the anchors when housed may be flush with the deck. The stern fire consists of a 6-in. gun mounted on the upper deck. There is no poop, but an extensive bridge aft as well as forward with a gangway between, made convenient also for working the boats. In addition to this after 6-in. gun, there is on either side a 12-pounder. On each broadside are three 4.7-in. quick-firing guns, firing through 180 deg. There are also 12 smaller quick-firing guns, so that the cruisers are well armed.

For protection there is an armored deck right fore and aft, and the engines are completely under it. Along either side are arranged the coal bunkers, while over the protective deck again there are coal bunkers, and these are divided longitudinally by three bulkheads, as well as by the usual athwartship divisions. The normal coal capacity is 500 tons: but this may be considerably augmented, so that in this, as in all other recent cruisers, a wide radius of action has been provided for.

The boilers are of the Belleville type, the engines of the triple expansion design.

LIQUID FUEL.

Experiments have been in progress for more than a year, chiefly in the Hudson river, with torpedo boat No. 2, belonging to the Maine. They have resulted so happily that the engineers have made a report favoring the adoption of the fuel under given conditions upon certain minor craft, such as tug boats and torpedo boats. If the results foreshadowed in this report shall be realized a revolution is at hand in the fuel for war ships and all ocean going craft.

The Experimental Board of Naval Engineers consists of Chief Engineer H. S. Ross, of the Massachusetts, and Chief Engineers Lewis J. Allen and George Currie, Jr. They were designated about a year ago, by Chief Engineer G. W. Melville, Engineer in Chief of the Bureau of

Steam Engineering, U. S. N., to experiment with an invention submitted by J. S. Zerbe, chief engineer of the Consolidated Gas Company.

A SEVERE TEST.

They have submitted the apparatus to the severest possible test. Their operations have been known to the naval officers of all the nations, and several foreign countries have applied to have a share in them, but this was refused, as it was deemed wise to preserve the utmost secrecy.

The tests of a new fuel for steam vessels are cheapness, ease of operation, economy of room and general efficiency. The Board reports favorably upon the Zerbe apparatus in respect of all these points. The evaporation was found to be seventeen, eighteen, nineteen and twenty pounds of water, at various pressure, to one pound of oil, or more than double that of the best coal with the same boiler. The pressure of steam was constant, which means economy of fuel and equalization of pressure upon the machinery. There were no ashes nor dirt to injure the fine mechanism, and no stokers were required. The fuel can be put on board at sea.

Other important advantages are claimed for the new device. It is said to be as safe as coal and to occupy so much less room that a vessel having a steaming radius of 1000 miles with coal would be able to steam 2000 miles with the same bulk of petroleum. The waste space now devoted to water ballast forms, it is said, a perfect petroleum bunker, to be reoccupied by water as the oil is consumed. For the commercial marine this would mean a cubic foot available for freight for every cubic foot of coal bunking space saved.

NEW FIRE BOX.

The equipment of the fire box constitutes the most important departure in the new invention. The grate bars of the ordinary furnace are utilized for the purpose of forming thereon a brick bed. This bed is composed of bricks which have grooves partially across one face. They are laid on the grate bars at an angle of forty-five degrees, thereby forming air ducts over the entire surface of the bed and also making a corrugated surface.

Instead of injecting the oil through round injectors, a fan shaped spray is distributed over this foraminous bed, which bursts into flame on striking the bed, heating up the latter to incandescence. The air passing through the grooves and uniting with the carbonic gases generated by the contact of the oil spray with the heated brick makes a perfect oxy-hydrogen flame.

For injecting the oil and breaking it up compressed air is utilized.

EXPERIMENT UNDER DIFFICULTIES.

The torpedo boat upon which the experiment was conducted was originally designed for coal, hence there was no available space within the hull in which to locate oil tanks. It was necessary to place tanks fore and aft within the cockpits. A specially designed duplex pump was located in the fire room, one side of which pumped sea water into the bottom of the oil tanks, and the other side of the pump was connected with the top of these tanks for the purpose of pumping oil from them to the burners in the furnace. By this means the tanks are always filled with liquid, preventing the swashing motion so dangerous and

[illegible] QUICK-FIRING [illegible]

[illegible] is a Mediterranean [illegible] with a new method of [illegible] The mounting is [illegible] the guns, and carry- [illegible] supported by the side brackets [illegible] the brake cylinders, and [illegible] guns are brought back auto- [illegible] the locking slide of the [illegible] system, with the central rod [illegible] has on each side a rod of different [illegible] and is connected to the cross- [illegible] gun, the larger enters the cylinder [illegible] a part of the liquid it contains; [illegible] pipe and valve in the piston of the central [illegible] compressed in front of the piston. At the [illegible] but a second pipe open to both sides [illegible] by a lever outside, allows the liquid pre- [illegible] back into the brake cylinder, under the in- [illegible] in the receiver, thus throwing the gun for- [illegible]. According to whether the bye-pass pipe is [illegible] moment of firing, the guns are run out at once, [illegible]. The central variable rods are fixed to the projections [illegible] upper part of the sleeve. They move, during recoil, inside the [illegible] thus constantly changing the area of the openings of the [illegible] devices are attached to the sleeve on the mounting. [illegible] trained for elevation by a toothed sector, fixed under the [illegible] gears a pinion worked through a countershaft by means [illegible] hand [illegible] wheel and a pitched chain. The turning platform [illegible] on a live ring of hard steel balls, and it can be trained either by hand or by an electric motor. The mechanism of this part of the mounting comprises a fixed toothed ring, two pinions gearing into it, and a third pinion on the shaft of which is mounted, by means of a special compensating device, a helicoidal gear. An endless screw drives this gear, and is itself actuated, either by a pair of bevel wheels connected with the electric motor, or by a pitched chain transmission worked by hand. By means of a clutch the hand or power gear can be thrown at once into operation. A supply of ammunition is furnished to the gun [illegible] a central endless chain moving with the platform on the well-known [illegible]et system, and delivering at the side of the mounting. Provision [illegible]e made for a store of projectiles being placed close to the platform. [illegible]ch case only the cartridges would have to be delivered from below.

This method of mounting, which is applicable to all calibres of quick-firing guns, possesses the following very considerable advantages: The weight and bulk of the mounting are reduced to a large extent, and consequently the weight and cost of the shield and local armor are also reduced. This reduction in weight means that the power of the ship for offensive purposes can be correspondingly increased. The axes of the two guns being as near as possible, the strain arising from firing one gun is reduced to a minimum, consequently the wear of the mechanism from lateral training is also reduced. The men training the guns have all the necessary mechanism conveniently arranged, so that the guns can be fired more rapidly and with a reduced *personnel*. Both guns are elevated simultaneously; from this it follows that after a round has been fired successfully, a second round can follow immediately, or if any correction is necessary it can be very rapidly executed. By this means the efficiency of the armament is increased. The arrangement has been developed from the twin mountings previously installed by M. Canet on the Prat, the Jauréguiberry, etc. But in these mountings the guns were trained independently, and were of necessity placed farther apart from each other.

EXPERIMENTAL TEN-INCH WIRE WOUND BROWN SEGMENTAL GUN FOR U. S. ARMY.

[Scientific American.]

The Ordnance Department U. S. Navy has taken in hand the construction for experimental purposes of a 10-in. wire wound Brown segmental gun.

The advantages claimed for the core of the gun in this system are as follows:

1.—In consequence of the small weight of each of the component parts of the gun, crucible steel can be used economically. 2.—The small size of the segments, and the ingot from which they are rolled, admit of being carefully cast and uniformly forged, so as to insure uniformity of metal and of being thoroughly annealed. 3.—As they can be readily rolled into shape, the method of construction is exceedingly economical. 4.—They can be thoroughly and conveniently inspected. 5.—The size and thinness of each segment insures a thorough and uniform tempering and annealing, if temper be considered desirable. 6.—The size of the segments admits of readily setting up conditions of special elasticity by cold work.

This latter feature is by far the most important one in this system of construction, as it renders it possible to use a character of steel far beyond anything heretofore employed in the core of a gun. The core of such a gun whose bars or shoes have been hardened, annealed and cold drawn could readily be wound so as to produce a compression between the segments of 112,000 pounds to the square inch without exceeding the elastic limit of the weapon.

In the manufacture of the 10-inch Brown gun the production of the segmental core is the most novel feature. The segments, which are made from open hearth steel, are cold drawn and are tapered and beveled in the working. This is done so accurately that no machining is necessary. They are assembled vertically, with the large end down, in much

the same way as a cooper assembles a barrel, and are temporarily held together with three-part clamps placed one foot apart. The core is then put in a lathe, the two ends are machined, and the breech and muzzle nuts are shrunk on. The lathe is then set at the taper of the finished gun and the outside of the core is turned down from nothing at the breech nut to a depth equal to the thickness of the wire, at twelve inches from said nut. Here the operation is again repeated for another twelve inches, and so on until the muzzle nut is reached. The steel wire is ¼ of an inch square in section, with a sectional area of $\frac{1}{16}$ of an inch. The end of the wire is keyed into the gun at the breech nut and it is wound on at the required tension by means of the automatic winding machine. When the wire reaches the shoulder it is tightly wedged in against it, turned over, and keyed into the gun. The next layer is started at the second shoulder, 24 inches from the breech nut, and wound back to the breech. The third starts at the breech and runs to the third shoulder, the successive layers running in contrary directions until the necessary amount of wire is laid on. The gun is then bored out, heated internally by gas, and shrunk onto a thin steel liner. The chase jacket is shrunk on in two foot sections. The trunnion jacket is interlocked at the breech end by shrinking on, and fits with a slip joint over the chase. The breech closure is screwed into the projecting end of the jacket, and the trunnion ring is screwed on over the front end of the same jacket, so that the recoil of the gun is taken up directly by the jacket and transferred by the trunnions to the gun carriage. The longitudinal stress is taken in part by the longitudinal segments. In addition to this, the method of cross wrapping the wire in itself imparts considerable longitudinal strength to the gun.

The winding of the wire at a constant tension is done by an ingenious machine. It consists of a stout frame, bolted to the lathe carriage, which is provided with a large overhead spool to carry the wire, and a small car which runs on a track at right angles to the axis of the gun. Upon the car are journaled two sets of adjustable steel rollers, between which the wire passes and by means of which the necessary tension is given to the wire as it passes to the gun. The pressure between the rollers is regulated by means of coil springs, controlled by thumb-screws. The two sets of rollers are geared to two brake wheels above and below the car. The upper brake wheel has a fixed brake. The lower brake is automatic in its action and is controlled by the position of the car. From the rear of the car a set of wires passes over a pulley which is suspended between the vertical frames, and down to a bracket which carries a certain amount of dead weight. The winding is started with the weight resting on the floor. The hand wheel on the brake is then turned until the weight is raised, when the tension in the wire equals the weight. As the car travels toward the gun, the brake wheel is released by an automatic gear and the car soon finds a position of equilibrium. The brakes are kept cool by water pipes.

The wire used in the construction of the 10-inch gun will have a total length of 75 miles.

The high quality of steel which it is possible to use in the segmental wire gun is evident from the official tests of the metal put into the 5 nch gun of this pattern. The segments showed an elastic limit 126,000 unds per square inch and an ultimate strength of 176,000 pounds per ire inch; the wire shows an elastic limit of 230,000 pounds and an nate strength of 262,000 pounds per square inch.

GROWTH OF THE U. S. NAVY.

The following tables, taken from the report of the Hon. Secretary of the Navy, represent the development of our new Navy during the past four years:

TABLE I.

VESSELS AUTHORIZED BY CONGRESS SINCE MARCH 4, 1893.

Name.	Dis-place-ment.	Speed.	Main battery.	Where built or building.	Contract date of completion.
	Tons.	*Knots*			
Kearsarge	11,520	16	4 13" B. L. R.; 4 8" B. L. R.; 14 5" R. F. G.	Newport News Shipbuilding and Dry Dock Co., Newport News, Va.	January 2, 1899.
Kentucky	11,520	16	. . do. . .	. . . do. . . .	do.
Illinois	11,520	16	4 13" B. L. R.; 14 6" R. F. G.	. . . do. . . .	Sept. 28, 1899.
Alabama	11,520	16	. . do. . .	Wm. Cramp & Sons, Philadelphia, Pa.	Sept. 24, 1899.
Wisconsin	11,520	16	. . do. . .	Union Iron Works, San Francisco.	Sept. 19, 1899.
Total . . (5)	57,600				
Gunboats.					
Annapolis	1,000	12	6 4" R. F. G.	Lewis Nixon, Elizabethport, N. J.	Feb. 20, 1897.
Vicksburg	1,000	12	. . do. . .	Bath Iron Works, Bath, Me.	Feb. 15, 1897.
Newport	1,000	12	. . do. . .	. . . do. . . .	do.
Princeton	1,000	12	. . do. . .	J. H. Dialogue & Son, Camden, N. J.	Feb. 20, 1897.
Wheeling	1,000	12	. . do. . .	Union Iron Works, San Francisco.	Feb. 28, 1897.
Marietta	1,000	12	. . do. . .	. . . do. . . .	do.
Total . . (6)	6,000				
Torpedo boats.					
No. 3	142	24.5	3 torpedo tubes; 3 1-pdr. R. F.	Columbian Iron Works, Baltimore, Md.	Aug. 3, 1896.
No. 4	142	24.5	. . do. . .	. . . do. . . .	do.
No. 5	142	24.5	. . do. . .	. . . do. . . .	do.
No. 6	*182	27.5	3 torpedo tubes; 4 1-pdr. R. F.	Herreshoff M'f'g Co., Bristol, R. I.	Aug. 19, 1896.
No. 7	*182	27.5	. . do. . .	. . . do. . . .	Nov. 19, 1896.
No. 8	182	26	. . do. . .	Moran Bros. & Co., Seattle, Wash.	Jan. 19, 1897.
No. 9	146	30	. . do. . .	Bath Iron Works, Bath, Me.	April 6, 1896.
No. 10	146	30	. . do. . .	. . . do. . . .	do.
No. 11	273	30	. . . .	Union Iron Works, San Francisco.	April 5, 1896.
No. 12	117	22.5	3 torpedo tubes; 3 1-pdr. R. F.	Wolff & Zwicker Iron Works, Portland, Oreg.	Oct. 6, 1897.
No. 13	117	22.5	. . do. . .	. . . do. . . .	do.
No. 14	†103	22.5	3 torpedo tubes; 3 1-pdr. R. F.	Herreshoff M'f'g Co., Bristol, R. I.	Oct. 6, 1897.
No. 15	†47	20	2 torpedo tubes; 1 1-pdr. R. F.	. . . do. . . .	do.
No. 16	†47	20	. . do. . .	. . . do. . . .	do.
No. 17	65	20	. . do. . .	Chas. Hillman Co., Philadelphia, Pa.	Oct. 7, 1897.
No. 18	65	20	. . do. . .	Columbian Iron Works, Baltimore, Md.	do.
Total . . (16)	2,098				
Submarine torpedo boat.	168	8	. . . .	. . . do. . . .	March 13, 1897.
Grand total	65,866				

* Approximate. † Trial displacement.

TABLE II.

NEW VESSELS PLACED IN COMMISSION MARCH 4, 1893, TO MARCH 4, 1897.

Name.	Type.	Displacement.	Main battery.	Date of first commission.
		Tons.		
Indiana . . .	Sea going coast-line battle ship	10,288	4 13″ B. L. R.; 8 8″ B. L. R.; 4 6″ B. L. R.	Nov. 20, 1895
Massachusetts .	. . . do.	10,288	. . . do. .	June 10, 1896
Oregon	. . . do.	10,288	. . . do. .	July 15, 1896
Maine	2d class battle ship .	6,682	4 10″ B. L. R.; 6 6″ B. L. R.	Sept. 17, 1895
Texas	. . . do.	6,315	2 12″ B. L. R.; 6 6″ B. L. R.	Aug. 15, 1895
New York . .	Armored cruiser . .	8,200	6 8″ B. L. R. 12 4″ R. F. G.	Aug. 1, 1893
Brooklyn . . .	. . . do.	9,271	8 8″ B. L. R.; 12 5″ R. F. G.	Dec. 1, 1896
Amphitrite . .	Low free-board coast defense monitor	3,990	4 10″ B. L. R.; 2 4″ R. F. G.	April 23, 1895
Monadnock . .	. . . do.	3,990	. . . do. .	Feb. 20, 1896
Terror	. . . do.	3,990	4 10″ B. L. R.	April 15, 1896
Katahdin . . .	Armored ram . . .	2,155	4 6-pdr. R. F.	Feb. 20, 1896
Total . .	. . . .	75,457		
Cincinnati . .	Protected cruiser .	3,213	10 5″ R. F. G.; 1 6″ B. L. R.	June 16, 1894
Raleigh . . .	. . . do.	3,213	. . . do. .	April 17, 1894
Columbia . . .	. . . do.	7,375	1 8″ B. L. R.; 2 6″ B. L. R.; 8 4″ B. L. R.	April 23, 1894
Minneapolis . .	. . . do.	7,375	. . . do. .	Dec. 13, 1894
Olympia . . .	. . . do.	5,870	4 8″ B. L. R. 10 5″ R. F. G.	Feb. 5, 1895
Detroit	Cruiser	2,089	9 5″ R. F. G.	July 20, 1893
Marblehead . .	. do.	2,089	9 5″ R. F. G.	April 2, 1894
Montgomery .	. do.	2,089	9 5″ R. F. G.	June 21, 1894
Castine	Gunboat	1,177	8 4″ R. F. G.	Oct. 22, 1894
Machias . . .	. do.	1,177	8 4″ R. F. G.	July 20, 1893
Total . .	. . . .	35,667		
Puritan . . .	Low free-board coast defense monitor	6,060	4 12″ B. L. R.; 6 4″ R. F. G.	Will be commissioned December 7, 1896.
Annapolis . .	Gunboat	1,000	6 4″ R. F. G.	Will be commissioned February 20, 1897.

TABLE III.

NEW TONNAGE AUTHORIZED BY CONGRESS AND NEW TONNAGE BEGUN AND PLACED IN COMMISSION SINCE MARCH, 1881.

March 4—	New vessels authorized.	New vessels begun.	New vessels commissioned.
	Tons.	*Tons.*	*Tons.*
1881-1885	23,076	12,368	. . .
1885 1889	67,183	34,814	7,863
1889-1893	66,618	98,164	54,832
1893-1896*	65,942	80,778	118,184

*To this table is to be added vessels that may be authorized during the coming session of Congress.

TABLE IV.

TABLE OF PRESENT STRENGTH OF SEVEN PRINCIPAL NAVIES.

Class.	England.			France.			Russia.			Italy.			Germany.			United States.			Spain.		
	Built.	Bldg.	Total.	Built.	Bldg.	Total.	Built.	Bldg.	Total.	Built.	Bldg.	Total.	Built.	Bldg.	Total.	Built.	Bldg.	Total.	Built.	Bldg.	Total.
Battle Ships:																					
1st class	22	12	34	10	8	18	5	6	11	8	2	10	4	2	6	3	6	9	1	..	1
2d class	12	..	12	11	1	12	5	2	7	2	..	2	7	..	7	2	..	2	..	..	..
3d class	11	..	11	2	..	2	..	.	..	5	..	5	3	..	3	..	..	..	2	..	2
Total	45	12	57	23	9	32	10	8	18	15	2	17	14	2	16	5	6	11	3	..	3
Coast defense ships	13	..	13	16	..	16	10	4	14	..	..	..	17	2	19	6	1	7	..	.	..
Cruisers:																					
Armored	16	..	16	9	1	10	9	1	10	1	5	6	..	1	1	2	..	2	3	4	7
1st class	11	10	21	2	4	6	2	..	..	..	..	..	1	..	1	3	..	3	1	..	1
2d and 3d class	51	24	75	10	9	19	3	1	4	16	1	17	3	5	8	13	..	13	7	..	7
Lookout ship or gunboats	19	..	19	12	..	12	..	..	..	..	..	..	11	1	12	9	9	18	22	..	22
Torpedo gunboats	34	..	34	12	3	15	8	..	8	15	2	17	9	1	10	..	..	..	3	4	7
Torpedo boat destroyers	..	..	98	..	..	3	..	..	1	..	..	1	..	..	11	..	..	1	..	2	2
Torpedo boats	..	..	160	..	..	241	..	..	161	..	..	176	..	..	145	3	15	18	19	4	23

COMPARISON OF THE LATEST BATTLE-SHIPS OF THE PRINCIPAL NAVAL POWERS.

	Nation.					
	United States.	England.	France.	Germany.	Russia.	Italy.
Name of Vessel	"Alabama."	"New Renown."	"St. Louis."	"Ersatz Preussen."	"Oslabya."	"St. Bon."
Length	368 ft.	390 ft.	385 ft.	397 ft.	402 ft.	344½ ft.
Beam	72	74 "	66½ "	66.93 "	70½ "	69¾ "
Mean draft	23 ft. 6 ins.	25 ft. 5 ins.	25 ft. 11 ins.	25 ft. 9 ins.	26 "	24 ft. 9 ins.
Displacement, tons	11,500	12,900	11,275	11,130	12,674	9,800
Indicated horse-power	10,000	15,000	14,500	13,000	14,500	13,500
Speed	16 knots.	18¾ knots.	18 knots.	18 knots.	17½ knots.	18 knots.
Coal, normal	800 tons.	...... tons.	680 tons.	650 tons.	...... tons.	...... tons.
Coal, maximum	1,200 "	1,850 "	1,100 "	...... "	...... "	1,000 "
Battery: Main	(4) 13-in. (14) 6-in.	(4) 12-in. (12) 6-in.	(4) 12-in. (10) 5½-in. (8) 3.9-in.	(4) 9½-in. (18) 6-in. (12) 3½-in.	34 guns.	(4) 10-in. (8) 6-in. (8) 4.7-in.
Battery: Secondary	.... (17) 6 pdrs. (6) 1 " (5) machn.	.... (16) 12 pdrs. (12) 3 " (2) machn.	(16) 1.8-in. (10) 1.4-in. (8) machn.	(12) 6 pdrs. .... (8) machn.		(2) 2.9-in. (12) 1.4-in. (2) machn.
Torpedo tubes	4	5	4	....	....	5
Armor: Belt	16½ ins.	8 ins.	15¾ ins.	11¾ ins.	9 ins.	9¾ ins.
Casemate	5½ "	6 "	3 "	5.9 "	....	4 "
Turrets	17-15 "	10 "	15¾ "	9.8 "	....	9¾ "
Barbettes	15 "	10 "	...... "	9.8 "	....	9¾ "
Protective deck	3 "	3 "	3½ "	2.56 "	....	3 "
Splinter deck	½-in.	....	...... "	¾ "	....	...... "

SHIPS OF WAR AND NAVAL NOTES.

[THE UNITED STATES.]

THE MASSACHUSETTS.

Between 7.30 and 9.30 P. M., Oct. 22, the full speed trial under natural draught prescribed by the Department's instructions was run. The average revolutions of the starboard engine were 101.26, of the port engine 101.15. Speed by patent log 12.9 knots. The engines ran smoothly and gave no trouble. The coal used was a mixture of Eureka and New River. The average indicated horse-power of the main engines for the two hours' run was 5044, and the average coal consumption per hour was 12,100 pounds, 230 pounds per horse-power.

The ship was run to the northward and eastward during the night of the 22nd, and on the morning of the 23rd was turned to the southward, keeping on soundings.

Two service charges were fired from each gun of the main and secondary batteries, with the exception of the one-pounders, one at level, and one at maximum elevation. The structure of the ship and the gun mounts showed ample strength, and freedom from any injury or strains.

The weather was smooth during the greater part of the trial. During the night of the 23rd there was a moderate swell, to which the ship rolled and pitched easily, showing so far as can be judged good qualities as a sea boat, and a stable gun platform.

Finally after careful observation of the vessel and her performance, the board reports: (1) That upon the trial no weakness, or defect, appeared in the hull, fittings or equipment, due to either defective workmanship or defective materials, or in the fitting, fixing, placing and securing of the armor, due to defective workmanship. (2) That no part or parts of the machinery were found defective in construction with respect to either workmanship or material, nor was there any failure, or breaking down or any deterioration observed of any part of the machinery, engines, boilers, or appurtenances, other than that due to fair wear and tear.

GUNBOATS VICKSBURG, NEWPORT, AND ANNAPOLIS.

On Saturday, December 5, were successfully launched the two gunboats Vicksburg and Newport, from the shipyard of the Bath Iron Works, Maine, and on Dec. 24 the Annapolis was launched from the shipyard of Lewis Nixon at Elizabethport, N. J.

These gunboats are of what is known as composite construction, the entire frame being of steel, and above the water each is plated with steel and planked below. The planking is covered with copper, the advantage of this over steel being that the vessel will not need docking for years and may make uninterrupted cruises of seven or eight years. Each boat has three full decks running the entire length of the vessel. The length over all is 200 ft. and 188 ft. between perpendiculars. The beam between mouldings is 35 ft. 5 in., and extreme beam 36 ft. The mean draft is 12 ft. and the displacement 1000 tons. As compared with the Machias and Castine these new boats are 22 ft. shorter, 4 ft. wider and of the same displacement. The rig is that of a barkentine and the area of the nine principal sails will be 11,500 ft.

The armament consists of six 4-in. rapid-fire breech-loading rifles, four

6-pound rapid-fire guns and two 1-pounders. One 4-in. gun will be mounted on the spar deck forward and one aft, with two on each side of the gun deck, amidships. The six-pounders are mounted one on each side forward, one on each side amidships, and one one-pounder on each side aft. There will be no gun sponsons.

Each gunboat will carry one 28-ft. steam launch, one 28-ft. cutter, two cutters 26 ft., one whaleboat 28 ft., one gig and one dingy, 28 and 18 ft. respectively.

On the lower deck is a general storeroom over the trimming tank forward. Aft of this is 40 ft. of berthing space, the width of the ship, a dynamo room on the port side and prison and ordnance storeroom to starboard. Still further aft come the boiler and engine rooms, completely surrounded by the coal bunkers. Then comes the ward room with eight staterooms. The extreme stern is occupied by storeroom and steam steering gear. The gun deck is an open deck only interrupted by the Hyde steam windlass, the galley, the engine and fire room hatches, the hospital and dispensary. Way aft on this deck are the captain's cabin, stateroom, and the quarters of executive and navigating officers and armory.

The spar deck is open and runs the full length of the craft. Forward is the pilot house, finished in mahogany, and a bridge extending from the pilot house to each side of the boat. The boilers are of Scotch type, two in number, 10½ ft. long and 10½ ft. in diameter, with a working pressure of 160 pounds.

The engine which will drive each boat is of the vertical triple expansion type, with cylinders 16, 22 and 36 in. diameter, respectively, and with a 24-in. stroke. Its horse-power is 800, one-half that of the Machias. The contract speed is 12 knots.

TORPEDO BOAT NO. 4.

Torpedo boat No. 4 was launched Nov. 10, at the Columbian Iron Works of Baltimore. This is one of the three 24½-knot boats building at the same works under the contract of May 3, 1895.

EXTRACTS FROM REPORT OF CHIEF OF NAVAL BUREAU OF ORDNANCE.

Captain Sampson, Chief of the Bureau, estimates that the work for the fiscal year of 1897 will require the expenditure of $9,164,620, the principal items of which will be as follows: Armor for vessels authorized, $7,720,796; reserve guns for auxiliary service, $400,000; fuel, tools, material and labor and reserve supply of guns, $850,000.

No change has been made or has been contemplated in the general system of gun construction which has been in use since the reconstruction of the navy was undertaken. Since the date of the last annual report of the Bureau 71 guns have been completed, viz: Thirty-seven 4-inch, fourteen 5-inch, seventeen 8-inch, one 10-inch, and two 12-inch. Fifty-six additional guns were ordered (twenty-seven 4-inch, thirteen 5-inch, eight 8-inch, and eight 13-inch), and the number of guns now in course of completion is 89. . . . The conversion of one of the ordinary type 6-inch guns into a rapid-fire gun has been completed, and the gun is now being tested at the proving ground. The Bureau expects to convert all the 6-inch guns as opportunity offers and funds become available. In

the meantime the manufacture of 6-inch R. F. guns with the Fletcher breech mechanism for battle-ships 7, 8 and 9, and for certain of the auxiliary cruisers, will be carried on.

The 6-inch R. F. mounts, Mark V, mentioned in the last annual report of this Bureau, have been completed, eight in all. A new design of a 6-inch pedestal mount, Mark VI, for rapid-fire guns has been completed and patterns are being made for the steel castings, and a type mount after this design will be begun as soon as the castings are received.

The requirements for armor-piercing shells have been increased in severity to meet the improvements in armor. These shells must now pierce a calibre of hard-faced armor in order to be accepted. The tests for the 10, 12 and 13 inch semi-armor piercing shells are the same. They must pass through a 7-inch nickel steel plate. The 8-inch common shells are required to go unbroken through a 4-inch mild steel plate. The 13-inch common shells, being of cast steel, are intended for use in target practice and have no ballistic test for acceptance. The 6-pounder shells have to penetrate a 3-inch mild steel plate without breaking. A large number of 5 and 6 inch projectiles are still needed for the outfits of ships already authorized by law, and, besides these, the Bureau urges that further appropriation be made for reserve projectiles. Experience has shown that lapse of time actually improves the quality of the forged steel tempered shell necessary for use against armor, and a large store of such projectiles should certainly be accumulated for use in an emergency.

Casual Cruisers.—Under the act of Congress authorizing steamships conforming to certain requirements to be inspected and classified as casual cruisers to be used in case of war, the following vessels have been registered: International Navigation Company: St. Louis, St. Paul, Paris, New York. Pacific Mail Steamship Company: Newport, City of Para. Red D Line: Caracas, Philadelphia, Venezuela. New York and Cuba Mail Steamship Company: Orizaba, Yumuri, City of Washington, Saratoga, Seneca, Yucatan, Seguranca, Vigilanca. Panama Railroad Company: Advance and Allianca. Pacific Mail Navigation Company: City of Sydney, City of Pekin, City of Rio Janeiro, Peru, Colon, San José, San Blas, San Juan, Acapulco. The vessels thus far inspected and classified will require forty-six 6-inch rapid-firing guns, twenty-seven 5-inch rapid-firing guns, one hundred and four 4-inch rapid-firing guns, fifty-four 6-pounder rapid-firing guns, eight 1-pounder rapid-firing guns and one hundred and twelve machine guns. The act contemplates the conversion into auxiliary naval cruisers of steamships of the first, second and third class only, consequently batteries are not assigned to those of the fourth class. The Bureau has in previous reports recommended that a yearly appropriation be made for the manufacture of guns and mounts for these vessels in order to render them of service in case of an emergency, and Congress, at its last session, appropriated the sum of $400,000 towards the armament of the vessels in question, and it is earnestly recommended that a similar appropriation be made for the next fiscal year, so that the work already begun may be continued until there is a sufficient number of guns and mounts to equip all of the vessels which are suitable for transports or cruisers. All these guns will be available any purpose as they and their mounts are made.

Details of Armament of Auxiliary Cruisers.

ATLANTIC SERVICE.

International Navigation Company:—

St. Louis,	8 6-in. rifles,	4 machine guns,	4 6-pounders.
St. Paul,	8 "	4 " "	4 "
Paris,	12 "	6 " "	6 "
New York,	12 "	4 " "	6 "

Pacific Mail Company:—

Newport,	8 4-in. rifles,	8 machine guns.
Columbia,	6 5-in. rifles,	6 " "
City of Para,	8 4-in. rifles,	8 " "
Lampasas (new),	6 5-in. rifles,	6 " "

Red D Steamship Company:—

Caracas,	8 4-in. rifles,	6 machine guns.
Philadelphia,	8 "	8 " "
Venezuela,	8 "	8 " "

Panama R. R. Company:—

Advance,	6 5-in. rifles,	6 machine guns.
Allianca,	6 "	6 " "

New York and Cuba Mail Steamship Company:—

Orizaba,	8 4-in. rifles,	6 or 8 machine guns.
Yumuri,	8 "	6 or 8 " "
City of Washington,	8 "	6 or 8 " "
Saratoga,	8 "	6 or 8 " "
Seneca,	8 "	6 or 8 " "
Yucatan,	8 "	6 or 8 " "
Seguranca,	6 5-in. rifles 4 4-in. rifles, 4 1-pounders, 3 machine guns.	
Vigilanca,	6 5-in. rifles, 4 4-in. rifles, 4 1-pounders, 3 machine guns.	
Cincho (new),	6 5-in. rifles,	6 machine guns.

PACIFIC SERVICE.

Pacific Mail Steamship Company:—

City of Sydney,	6 6-in. rifles,	10 6-pounders, 2 machine guns.
City of Pekin,	6 5-in. rifles,	12 6-pounders.
City of Rio de Janeiro,	8 4-in. rifles.	
Peru,	9 5-in. rifles,	12 6-pounders.
Colon,	6 5-in. rifles,	8 machine guns.
San Jose,	6 4-in. rifles,	6 " "
San Blas,	6 "	6 " "
San Juan,	6 "	6 " "
Acapulco,	8 "	6 " "

U. S. S. Terror.

TESTING THE PNEUMATIC APPARATUS.

The U. S. S. Terror ran ten miles out to sea Nov. 19 to make a trial of the pneumatic system of working her guns, turrets and rudders. The rudder was turned from hard a-port to hard a-starboard in six seconds. Remarkable time was also made in turning the monster turrets. In less than three seconds after the air had been exhausted from the com-

pressors and the machine started a turret weighing more than 250 tons was swinging in its circle. The compressor generated its full force of 125 pounds pressure in the short time of forty-five seconds. There was no vibration to be felt in the turret, and the monster guns showed not the slightest tremor as they swung around. A test was made of moving both turrets, elevating the guns, and swinging the rudder by means of one compressor. In fifty-two seconds both turrets were completely swung around.

[ENGLAND.]

THE PRINCE GEORGE.

[JOURNAL OF THE ROYAL UNITED SERVICE INSTITUTION.]

The new first class battle-ship Prince George has completed all her steam trials successully. Her engines are identically similar to those fitted in Hood, Royal Sovereign, Repulse, and Empress of India. Each of the twin screws is driven by an independent set of engines, with three vertical cylinders, of collective power of 6000 horses, giving an aggregate I. H. P. of 12,000 with forced draught, and 10,000 with natural draught. The high pressure cylinder has a diameter of 40 inches, the intermediate cylinder 59 inches, and the low pressure cylinder 88 inches, and the length of the stroke is 4 feet 3 inches. There are thirty-two furnaces, and steam is supplied from eight cylindrical boilers. which are capable of carrying 150 lbs. pressure per square inch. The total heating surface is 24,400 square feet. The main condensers have a total cooling surface of 13,500 square feet. The ship is lighted by electricity, Brotherhood's compound double-acting engines having cylinders coupled direct to a Siemens iron-clad dynamo being capable of giving 600 amperes and 80 volts at a speed of 300 revolutions per minute, with a steam pressure of 100 lbs. to the square inch. During the eight hours' run under natural draught the ship was drawing 24 feet 11 inches forward and 25 feet 2 inches aft, and had 150.7 lbs. of steam in the boilers, the vacuum being 25.7 inches starboard and 25.5 port. With a mean of ninety-seven revolutions a minute the engines developed 10,464 H. P., or 464 above the contract, the air pressure in the stoke-holds being 0.44 inch. The speed registered by patent log was 16.52 knots, and the coal consumption was 2.3 lbs. per I. H. P. per hour. During the four hours' run under forced draught, she was drawing 24 feet 9 inches forward and 25 feet 3 inches aft, and the steam in boiler was 152.3 lbs., the vacuum being 26.4 starboard, and 26.3 port. The mean revolutions were 101.56 starboard and 101.98 port, which gave a mean I. H. P. of 6104 starboard and 6149 port, or a collective H. P. of 12,253, the contract of 12,000 H. P. being thus exceeded. The stoke-holds were remarkably cool with an air pressure of 1.2 inch, and the speed by patent log was 18.3 knots. The thirty hours' coal consumption trial was also most satisfactory. Drawing 24 feet 6 inches forward and 25 feet aft, there was a pressure of 137 lbs. of steam in the boilers and a vacuum of 27.8 inches port, while the revolutions were 83 per minute starboard and 82.8 port, giving a total I. H. P. of 6211. The speed was 14.70 knots an hour, and the coal consumption 1.7 lb. per I. H. P. per hour.

The only novelty in the machinery of the Prince George is the steering gear, which is similar to that of the Lucania and the Campania, and has never previously been tried on a war ship; but seeing at

a preliminary trial 34° of helm was obtained in 12 seconds, and the whole arc from starboard to port in 19 seconds, against the 30 seconds which is regarded as good time by the older methods, it is probable that Brow's hydraulic telemotor may be heard of again at ships' trials. The steering engine being directly attached to the rudder head dispenses with chains or wire ropes, and thus gets rid of the danger of fracture of ropes and chains as well as of the noise accompanying their working. The object of such a telemotor as is fitted in the Prince George is to supply a means of communication that shall be frictionless, however tortuous the line may be, and though there are five stations in the ship this object seemed to have been fully attained. The motive power of the apparatus is glycerine and water, which is forced through one pipe or another in such a manner as to turn the rudder to port or starboard, while the mechanism is of so sensitive a character that no great physical labor is involved in using it.

The gun trials of the Prince George have been as satisfactory as her steam trials. The trials were in charge of Captain E. F. Jeffreys and the officers of the Excellent gunnery establishment and commenced by testing the four 12-inch (46-ton) wire gun. The three rounds from each gun were so arranged as to make the tests with regard to loading and firing thorough in every respect. The guns were trained to various degrees of elevation, and the firing was both ahead and astern, as well as from abeam. The last two rounds from each barbette were fired simultaneously. The testing of the twelve 6-inch guns consisted of two rounds being fired from each gun on various bearings. Four rounds were fired from each of the sixteen 12-pounder guns on different bearings, and a similar number from the guns mounted in the tops. There are eight Maxim guns, and these were tested by fifty rounds being fired from each. The whole of the firing from the secondary armament was at targets, and in this case the results were also most satisfactory.

The general arrangements of the Prince George and her sisters are the same as those in the Majestic and Magnificent, but with some slight modifications and improvements. The mountings and machinery for working the heavier guns are the outcome of the determination of the Admiralty to have everything arranged as far as possible to work by hand as well as by power. Elswick designs were adopted, and the system, which has now had a year's trial in the Majestic and Magnificent, gives general satisfaction. The guns are provided with thrust rings which fit into corresponding grooves in the cradle, and the gun is kept securely attached to the cradle by means of steel keys. The gun and mounting (when the gun is in the firing position) balance about trunnions fitted to the sides, which admit of the gun being elevated or depressed with comparative ease by hand. The main system for working the guns and mountings is hydraulic, but, as an alternative, hand gear is provided, both for revolving the turntables and otherwise working the guns. It was determined after the trials of the Majestic to fit electric motors to assist the hand training gear, and this modification has been adopted more or less as an experiment in the Prince George where each turntable will have one 5 H. P. motor arranged in such a manner that it will greatly assist the turning by hand. Also in the hand elevating gear for the guns a 2½ H. P. motor has been arranged to work the elevating pump.

Another feature of the design common to the Prince George and the later ships of the Majestic type is the alternative loading ar-

-ıption trial were as follows:—Speed of ship, 17.24 knots; steam pres- e in boilers, 142 lbs. per square inch; revolutions per minute, 116; -an I. H. P., 4916; consumption of coal, 1.47 lb. per I. H. P. per hour.

The Powerful.

The new first class cruiser Powerful completed two of her trials .uccessfully. She was first run for thirty hours at 5000 I. H. P., or one- ıith of her maximum H. P. The run was made between Brighton and ·ıe Start in the English Channel, and fine weather with a moderate ·reeze was experienced. Although in addition to the main machinery :hirty-four out of the ninety-five auxiliary engines that the ship contains .vere in constant use, there was no difficulty in maintaining the required II. P. with sixteen out of the forty-eight boilers, and when four runs were made over the measured mile in Stokes Bay the ship made an average of 14.35 knots. In the first and third hours against the wind and with the tide the speeds, respectively, were 15.35 and 15.0, and in the second and fourth hours against the tide and with the wind, the speeds were 13.53 and 13.80, with 5200 I. H. P. The mean temperature in the stokeholds was about 85, but when going head to wind the temperature in the engine room was quite cold. The revolutions varied according to the force of wind with or against the ship from 66 to 69 per minute, and the I. H. P. ranged from 4850 to 5200, both port and starboard engines contributing a remarkable equality of power. At no period in the trial did the engines give the least trouble, whilst the highest point reached in the coal consumption was 2.6 lbs. per I. H. P., but this comparatively high rate was due to several fires and tubes being cleaned at the same time. The official report of the trial showed that the draft of water was 27 feet 3 inches forward and 27 feet 2 inches aft, and the steam in the boilers was 225 lbs. to the square inch, the vacuum being 26.8 inches starboard and 27 inches port, while the mean revolutions were 67.4 starboard and 67 port per minute. The average I. H. P. was 5008, and the speed by patent log 14 knots.

In the second trial, which was the severest any war-ship has yet accomplished, the ship steamed for thirty consecutive hours at an average of over 18,000 I. H. P. Leaving Spithead at 6 o'clock on the morning of the 13th ult., by 8.30 the engines had worked up to the stipulated H. P., and the trial then commenced. Start Point was reached by 1 o'clock, and the ship headed at once for the measured distance of twenty-three miles between Rame Head and Dodman Point, over which these runs were made at 18,000 I. H. P., at a mean speed of 20.6 knots. When darkness set in a due westerly course was taken in order to avoid the track of vessels in the Channel, and the ship steamed to a point about sixty miles beyond the Scilly Islands, where she turned and got on the measured distance on the Cornish coast at 8 o'clock the next morning. Three other runs were then made, when the engines were working at 18,650 I. H. P., and a mean speed of 21 knots was recorded. At the 5000 I. H. P. trial the coal consumption was 2.07 lbs. per I. H. P. per hour, but at the second trial it was reduced to 1.838 lb. The trial showed that, taking the coal consumption per I. H. P. per hour as the criterion, 15,000 I. H. P. would give the economical speed, while a careful calculation proved that during the trial the cost of producing the steam, including coal and labor, was an infinitesimal fraction under one penny per revolution, each revolution propelling the ship a

distance of 20 feet. As in the previous trials there was practically no bow wave, and from first to last there was an ample supply of steam, while the machinery gave no trouble of any kind. The draft of water forward was 27 feet 4 inches, and the amount of steam in boilers 232 lbs. per square inch. The starboard vacuum was 26.7 inches, and port 26.5 inches, while the revolutions were [illegible] starboard and 101.98 port per minute. Both engines gave a fairly equal amount of power, the starboard being 9188 and the port 9245, or a collective I. H. P. of 18,433.

The Juno and the Doris.

The Juno, second class cruiser, on her natural draught trials developed [illegible] I. H. P. with a speed of [illegible] knots over a measured course. On her four hours' forced draught trial she attained a maximum I. H. P. of over 10,000, with a mean speed by measured distance of 20.75 miles per hour.

The Doris, sister ship, made 19.1 knots with 8392 I. H. P. on her natural draught trial. On the forced draught trial she attained 9851 I. H. P.; the speed could not be accurately determined on account of the high seas and strong wind; it was estimated at 20.1 miles.

The Pelorus.

The third class cruiser Pelorus completed a series of trials in the English Channel on November 2. She proved herself the fastest ship of her size in the Navy, on her full power trials. She is 300 feet long, 36½ feet beam, and at 13½ feet draft displaces 2135 tons.

The features of this class is the adoption of the water-tube boiler with small tubes, viz. the Normand boiler. In the Pelorus there are eight boilers, with a combined heating surface of 15,800 square feet, and a grate area of [illegible] square feet. On her forced draught trial the power developed was [illegible] indicated horse-power, while the speed of the ship was 20.73 knots.

The Diadem.

On the [illegible]th of October the new first class cruiser Diadem was launched from the yard of the Fairfield Shipbuilding Company at Govan, on the Clyde. The contract for the Diadem was placed last November, and her keel was laid down in January of this year, so that her construction has occupied only ten months, which is a record as far as this type of ship is concerned. Three other vessels of the same dimensions and arrangement were ordered along with the Diadem, and are building at Clydebank, Barrow, and Pembroke respectively. They are named the Europa, Niobe, and Andromeda. The dimensions of the Diadem are as follows:—Length between perpendiculars 435 feet, on the load water-line 455 feet, beam 69 feet, and depth moulded [illegible] feet [illegible] inches, with a displacement of 11,500 tons, on a mean draft of water of 25 feet 3 inches. The hull is built of steel throughout, and is subdivided longitudinally and transversely by numerous bulkheads, while the double bottom extends from end to end. Externally the hull is encased with 4-inch teak planking from the keel to about 4 feet above the normal water line, and this will eventually be covered with copper sheathing. The steel protective deck, which extends throughout the whole length of the ship, is arched transversely, so that at the sides of

the vessel it is about 7 feet below the water line, while at the fore and aft middle line it rises to a height of 3 feet above the water. This deck, which varies in thickness from 6 inches to 3 inches, covers the machinery, boilers, magazines, stores, etc. The Diadem is intended to steam, with full power, at 20.5 knots, and she will be fitted with two sets of triple expansion engines, capable of developing collectively 16,500 H. P. Each set drives a separate bronze propeller, and has four cylinders, the diameters being 34 inches, 55½ inches, and two at 64 inches, the stroke in each case being 48 inches. The engines are designed to run at 110 revolutions, giving a piston speed of not less than 880 feet per minute. Steam will be supplied from thirty Belleville water-tube boilers, having an aggregate heating surface of 45,920 square feet and a grate surface of 1450 square feet. The total weight of the boilers will be about 720 tons, and the propelling machinery will weigh 1530 tons. The normal bunker capacity is 1000 tons, but if required arrangements have been made whereby double this amount of coal may be carried. The armament is to be composed of Q. F. guns entirely, and she will carry sixteen 6-inch and fourteen 12-pounders, twelve 3-pounders, and eight Maxim machine guns, besides three torpedo discharge tubes, of which two are submerged.

The Proserpine.

The Proserpine, third class cruiser, was launched on Saturday, December 5. The Proserpine was laid down on March 2 last, and her principal dimensions are as follows:—Length, 300 feet; beam, 36 feet 6 inches; maximum load draft, 15 feet; displacement, 2135 tons. Her armament will consist of eight 4-inch 26-cwt. quick-firing guns, eight 3-pounder quick-firing guns, two .45-inch Maxim guns, and two 14-inch torpedo tubes. She will be fitted with triple expansion engines and water-tube boilers. Her machinery, which is being manufactured at Devonport Dockyard, is designed to indicate 7000 horse-power and to give her a speed of 20 knots. She will have Thornycroft boilers. When commissioned she will have a complement of 225 officers and men.

Trial Trips of Destroyers.

The 30-knot torpedo boat destroyers Sparrowhawk, Virago, Quail and Thrasher, built by Laird Brothers, all passed successful trials, exceeding contract requirements.

The Star exceeded 30 knots speed on two hours' run.

Foam and Mallard were launched on October 8 and November 19, respectively, from the yard of John L. Thornycroft & Co.

New British Cruisers.

The Admiralty have just ordered four new first class cruisers of 11,000 tons displacement—the Argonaut, to be built and engined by Messrs. J. and G. Thomson, Limited, Clydebank; the Ariadne, to be constructed by the Fairfield Company, Limited, Glasgow; the Amphitrite, to be built by the Naval Construction and Armaments Company, Limited, Barrow-in-Furness; and the Spartiate, to be built at one of the dockyards. The engines of the last-named are to be made by Messrs. Maudslay, Sons, and Field, London. The vessels are to be of the same type as the Niobe, of which four were ordered last year, one each from the

three companies named. The new vessels are to be 435 feet long, 69 feet beam, by 39 feet 9 inches moulded depth. They will have forecastle and a boat deck, but no poop. At 25 feet 3 inches draft the displacement will be 11,000 tons. The armament will consist of sixteen 6-inch quick-firers, twelve 12-pounders of 12 cwt., two 12-pounders of 8 cwt., three 3-pounders, eight .45-inch Maxims, with two submerged torpedo tubes, and one above water at the stern. The protection will be by a 3-inch and 4-inch deck, having a rise of 10 feet, with coal bunkers below and above the deck, along the sides of the machinery and boiler compartments. There will be two sets of four-cylinder triple expansion engines, the diameters of cylinders being 34 inches, 55½ inches, and two of 64 inches, with a 48-inch stroke. Instead of having the high pressure cylinder forward, with the intermediate next, and the two low pressure aft, it is proposed to put a low pressure cylinder at each end, with the view of economizing space. The engines, too, will run faster than those in the class now building—120 instead of 110 revolutions—so that the power will be increased from 16,500 to 18,000 indicated horse-power, giving 20¾ instead of 20¼ knots. The Belleville boilers will be slightly different. Over the ordinary series of elements there will be a corresponding number of elements, of smaller tubes (2¾ inches in diameter) forming economizers, and between the two a combustion chamber into which air will be injected by nozzles. This has been adopted to improve the circulation, and consequently the economy. There will be 30 boilers in all, 18 of them with eight large and eight small elements, and 12 with seven elements. The total heating surface will be 47,880 square feet, of which 15,505 square feet will be in the feed-heating tubes. The total grate area will be 1390 square feet. The steam pressure at the boilers will be 300 lbs., and at the engines 250 lbs. The contract price for each cruiser is said to be about £445,000.

[FRANCE.]

THE GAULOIS.

The new first class battle-ship Gaulois was launched at Brest, October 6; she is a sister ship of the Saint Louis, launched at L'Orient, September 8, and of the Charlemagne.

The Gaulois has been only 10 months on the stocks; she will, however, scarcely be completed before the middle of 1899. Her dimensions are as follows:—Length, 385 feet 6 inches; beam, 66 feet 6 inches; and with a draft of 27 feet 6 inches the displacement is 11,275 tons. Four 30-centimetre (11.8-inch) guns are mounted in pairs in turrets, one forward and one aft, protected by 15.7-inch armor, and can be worked either by hand or electricity; and there are ten 5.5-inch Q. F.'s, of which eight are in a redoubt on the upper deck in angle ports, four for stern fire, separated by steel splinter bulkheads and with 3 inches of steel for protection, and the other two in sponsons on the spar deck, where also are eight 3.9-inch guns. On the superstructure and in the two fighting masts sixteen 1.8-inch and eighteen 1.4-inch guns are mounted. The ship has an end-to-end belt of Harveyized steel, 6 feet 7 inches deep, the extremities being of special nickel or chrome steel, with a maximum thickness of 15.7 inches amidships, surmounted by another light belt 3 feet 3 inches wide of 3-inch nickel steel, and there are two steel decks (3.5-inch) severally at the level of the top and bottom of the

main belt, the intermediate space being subdivided for coal stowage. Three triple expansion engines, driving as many screws, are supplied by twenty sets of Belleville boilers, with a maximum of 14,000 H. P. (forced draught), giving a speed of 18 knots. The extreme coal capacity is 1000 tons, but the normal coal supply is only 570 tons.

THE CATINAT.

The second class cruiser Catinat was launched at Havre, from the yard of the Société de la Mediterranée, on October 8. She is a sister vessel to the Protet now building by the Société de la Gironde at Bordeaux, and her dimensions are as follows:—Displacement, 4065 tons; length, 101 metres (330 feet); beam, 14 metres (45 feet 6 inches); mean draft of water, 6 metres (19 feet 6 inches). She has twin screws worked by triple expansion engines of 9000 I. H. P., and her estimated speed is 19 knots; the engines are vertical triple expansion and the boilers are of the Belleville water-tube type. The coal supply is 384 tons, giving a radius of action of 6000 miles at 10 knots and 1000 miles at full speed. For protection there is a 2.5-inch steel deck, and the guns have 2-inch steel shields. Her armament comprises four 16-centimetre (6.2-inch) guns, four 10-centimetre (3.9-inch), ten 47-millimetre and ten 37-millimetre, all Q. F.'s, and she has two submerged torpedo tubes. She is to be completed in February, 1897, and her total cost is 8,079,302 francs.

The new second class cruiser Pascal has been undergoing her trials at Toulon. With the engines developing 7232 I. H. P., a mean speed of 18.5 knots was maintained for three hours, the consumption of coal per I. H. P. per hour being 0.838 kilogramme, and for a square metre of grate surface per hour 93.019 kilogrammes.

The new torpilleur-de-haute-mer Mangini, at her trials off Lorient, attained a speed of 27 knots, exceeding the contract speed by 2 knots; she has been built by the Société des Ateliers de la Loire.

The new torpedo-depot-ship Foudre, at her full speed forced draught trials, maintained a mean speed of 19.9 knots for the three hours; it has not been definitely decided to what use she is to be turned.

GUN TRIALS OF THE DRAGONNE.

The not (it would seem) very novel idea of mounting a single heavy gun in a small vessel was first proposed during the ministry of the late Admiral Aube in 1886, and a small vessel of 80 tons, named the Gabriel Charmes, was constructed to mount a gun of 14 centimetres (5.5 inches). The trials with this vessel, however, did not excite any special interest and the matter dropped. Under M. Lockroy's ministry the idea was taken up, but instead of constructing a special vessel, the Dragonne, of 395 tons, was utilized, and a shell gun of 155 millimetres (6 inches) mounted on a land carriage was placed on board.

The object of the trials was to demonstrate the advantages of this method of operating against land defenses, especially when the latter were placed at an altitude and are consequently beyond the reach of the ordinary sea fire. The experiments have been fairly successful. The

Dragonne is a vessel of 395 tons, and the trials were carried on in a swell which rolled her 10 deg. Ten shots were fired at a distance of 5200 m., five at anchor and five running fire, and high explosives were used. They all fell within a rectangle of 400 m. on the shores, a result that would have done serious harm to a large fort on the coast, whereas the fire of the fort would have been practically useless against a slight moving object like the Dragonne.

The second trials made a few days later were equally satisfactory. They were made at night, against the old transport Panama, at a range of about 400 metres. There was a heavy sea on and yet half of the projectiles struck the target.

Ship Building Notes.

The Minister of Marine has placed an order with the Normand firm of Havre for a new torpilleur-de-haute-mer of 1250 tons with a speed of 30 knots, to be called the Cyclone, and for two torpedo-avisos of 300 tons, to be called the Durandal and Hallebarde, which are to have a speed of 26 knots. In view of the miscalculation regarding the stability of some of the recent French war vessels, the Minister of Marine has also created a special commission whose duty it will be to study at six months intervals the changes in the condition of the stability of ships under construction as fresh material is worked into them.

Some particulars are given in the French newspapers of the new French battle-ship Henri IV, from which it appears that there have been very considerable modifications in the original design. As she now stands she will be a first class battle-ship of 8948 tons, 353 feet long, 73 feet in beam, armed with two 11-inch guns, seven 5.5-inch, and twelve 1.8-inch quick-firers. She will have three screws, and engines of 11,500 horse-power, which will give her, at natural draught, a speed of 17 knots. She has two submerged torpedo tubes. Her keel was laid at Cherbourg in July. Eighty thousand pounds will be expended upon her in 1897, and she will join the fleet in 1901. As far as can be gathered, she will be of the Jemmapes type, modified and improved. A similar ship is to be laid down at Brest in 1897.

Naval Budget for 1897.

It is stated that the programme of naval construction proposed by the French Government and approved by the Budget Commission comprises the following vessels:—One battle-ship, one first class cruiser, two first class cruisers for coast defense, one third class cruiser for coast defense, one gunboat, one torpedo boat destroyer, and two first class torpedo boats.

The battle-ship A3 will be built at Brest and will be similar to the Henri IV building at Cherbourg. Her displacement will be 9000 tons; she will have water-tube boilers, and her speed is to be 17 knots; her armament and its disposition on board have not yet been settled; cost, exclusive of armament, 18,449,400 francs.

The first class cruiser C3 will be built at Toulon; she will be an armored cruiser, similar to the Jeanne d'Arc building at that port. Her displacement will be 11,270 tons, with a length of 460 feet and a beam of 61 feet. The engines will be vertical triple expansion, driving

three screws, and the boilers are to be of the Normand water-tube type, while the engines are to develop 28,500 I. H. P.; speed, 23 knots; radius of action at 10 knots, 13,500 miles, and 2000 miles at full speed. Armament—two 19-centimetre (7.4-inch), eight 14-centimetre (5.5-inch) Q. F., twelve 10-centimetre (3.9-inch) Q. F. guns, and twenty-four 3-pounder and 1-pounder Q. F. guns, with two under-water torpedo tubes; cost, 24,673,771 francs. She will be wood-sheathed and coppered.

One of the first class station cruisers, D2, will be built at Lorient, the other by a private firm of shipbuilders. Displacement 5500 tons, with a length of 438 feet and a beam of 48 feet. The engines are to be vertical triple expansion, driving three screws and developing 17,100 I. H. P., and the boilers will be Normand water-tube, giving a speed of 23 knots. Armament—eight 16-centimetre (6.2-inch), twelve 47-millimetre guns, and two submerged torpedo tubes; cost, 10,674,811 francs. They also will be wood-sheathed and coppered.

The third class coast defense cruiser will be a sister vessel to the D'Estrées, in course of construction at Rochefort. Its displacement will be 2452 tons, its engines will be of 8500 horse-power, and its speed 20.5 knots. Its armament will consist of two guns of 14-centimetres, four of 10 centimetres, and eight of 47 millimetres.

The plans of the destroyer M2 are not yet completed, but she will have a speed of 26 knots, and the radius of action of 2500 miles at 10 knots.

The gunboat is intended for distant stations, and will be constructed by a private firm on the lines of the Surprise. It will have a displacement of 629 tons and a speed of 13 knots. It will be equipped with two guns of 10 centimetres, four of 65 millimetres, and four of 37 millimetres. All the guns of the new vessels, beginning with those having a calibre of 16 centimetres, will be quick-firing.

[Russia.]

The Rotislav.

[Journal of the Royal United Service Institution.]

A further advance has been made towards the strengthening of the already formidable Black Sea fleet by the launch at Nicolaieff, in the presence of H. I. H. the Grand Duke Alexis, Commanding Admiral of the Russian Navy, of the new first class battle-ship Rotislav. Her dimensions are as follows:—Length, 341 feet; beam, 66 feet 6 inches; and with a draft of 24 feet she will displace 8880 tons. Protection is afforded by a belt of compound armor which extends nearly four-fifths the length of the ship, reaching 3 feet 3 inches above the same below the water line, and is 16 inches thick amidships, tapering to 12 inches at the extremities; above this belt rises a central redoubt, 150 feet long, protected by 5-inch armor, with armored transverse bulkheads of the same thickness; the armored deck is 3 inches thick, tapering to 2 inches. There are two vertical triple expansion sets of engines, with sixteen cylindrical boilers, which are to develop 8500 I. H. P. under forced draught, giving a speed of 15 knots. The normal coal stowage is 550 tons, but 800 tons can be carried on an emergency, giving a radius of action of 2000 sea miles at 10 knots. The armament consists of four 12-inch guns in couples in turrets, one forward and one aft, protected by 12-inch armor tapering to 10 inches; each pair of guns has an arc

of training of 270°; six 5.9-inch Canet Q. F. guns in the central redoubt; sixteen 3 and 1-pounder Q. F. guns and six torpedo tubes, one bow, one stern, and four broadside. All the guns will be made by the Obukoff Steel Works. Twenty-five months have elapsed since the keel of the ship was laid.

Ssissoi Weliki.

The battle-ship Ssissoi Weliki on a trial trip over the measured mile, on October 17, averaged 15.65 knots, with 82 to 89 revolutions and 8495 indicated horse-power. The displacement was 9762 tons.

Torpedo Boats with Liquid Fuel.

A special commission having tested the naphtha heating arrangement of torpedo boat No. 102, Wyborg, it has been decided to take her as a model after some minor changes and improvements have been made. All first class torpedo boats with locomotive boilers are to be fitted for naphtha heating. Those fitted with water tubular boilers are not to be altered, as the Newski Works will deliver six first class torpedo boats in the coming year, fitted with Du Temple boilers, which are adapted to the use of naphtha fuel.

All the torpedo boats so altered may, in case of necessity, use coal. The coal bunkers are to be subdivided into tanks of about 3.3 tons capacity each for the naphtha, cocks being fitted for drawing off the water. Colored glasses and prisms permit observation of the combustion in the furnaces. Changes and improvements will be made as suggested by trials.

Submarine Boat.

A submarine boat, designed by Mr. Pukalow, is building in Cronstadt. It is 19 feet long, so as to be carried on board ship. The motive power is electricity from storage batteries, sufficient to impart a speed of 10 knots during two hours' run. One man can manage the boat, which is adapted for surface runs as well.

Armor Trials.

During the first week in November armor tests of 10-inch Harveyized plates, furnished by Krupp, were held at Ochta. The plate chosen was placed at a distance from the muzzle such that the striking velocity would be 2300 feet per second. Two 8-inch steel Perm shell were fired from a 35-calibre gun; the velocity at target and pressure in chamber were taken each time. The results were highly satisfactory, the armor standing the test well enough to determine its acceptance. Both shell penetrated about 5 inches, the heads remaining imbedded in the plate, which showed no cracks. After the official test, an 8-inch cast steel Perm shell was fired at the plate from a 45-calibre gun and went through. The velocity before impact was 2850 feet, and after penetration 698 feet per second.

Naval Academy at Nicolaieff.

New regulations have been promulgated for the Naval Academy at Nicolaieff, instituting special courses for officers in navigation, hydrography, naval construction, and engineering, as well as a one-year special

course in naval history. A course in naval tactics will be open to staff officers and senior lieutenants who have six years' sea service, the number of students being limited to eighteen. The sessions for study will last seven months each year.

[SPAIN.]

THE FUROR AND TERROR.

[ENGINEERING.]

The torpedo boat destroyers Furor and Terror, built by Messrs. James and George Thomson, Limited, Clydebank, for the Spanish Government, have now completed their official trials. On Friday, November 20, the Terror, having previously made a natural draught trial on which a speed of 22½ knots was attained, was put through the severer ordeal of the forced draught or full power trial, consisting of four runs on the measured mile at 28 knots, which speed was by contract to be maintained during a further trial of two hours' duration. The prescribed speed was exceeded without difficulty on the Skelmorlie measured mile, and was maintained with great regularity during the subsequent two hours' run. In the teeth of a strong south-westerly breeze the vessel behaved admirably, and there was almost a total absence of vibration, in spite of the high power necessarily developed. The vessels are 220 feet long and 22 feet broad, being thus somewhat larger than any of the destroyers of the British Navy. In explanation of this it may be stated that the load carried on the trial is more than twice as great as in the case of the British boats. The Furor and Terror are, moreover, fitted out with various appliances to render existence on board more endurable in a tropical climate. There is a sheathing of teak planks over the steel upper deck, complete awnings all forward and aft, and an installation of electric ventilating fans throughout the crew's and officers' quarters. The ships are lighted by electricity throughout. The armament consists of two 14-pounder quick-firing Maxim-Nordenfeldt guns, the one mounted forward and the other aft; two 6-pounders of the same pattern on the broadsides; and two automatic Maxim guns on the port and starboard bow. There are also two 14-inch deck pivoted torpedo tubes on the Schwartzhoff system. At the conclusion of the speed trials the firing trial of the guns was carried out. The Spanish Government was represented by Commodore Camara, chief of the Naval Commission; Captain Peral, Captain Carlier, and other officers.

NEW FLOATING DOCK.

The Spanish Government has just concluded a contract with Messrs. Swan and Hunter, Limited, of Wallsend, for a floating dock for the port of Havannah. This dock is to be built from the designs and under the superintendence of Messrs. Clark and Standfield, of Westminster, and is to be one of their lately introduced type of floating graving dock, specially designed for lifting ironclads as well as ordinary vessels. The length of the dock will be 450 feet, the clear width between the broad altars 82 feet, and the normal depth of water over the sill 27 feet 6 inches, which can, however, be increased to 30 feet if necessity arises. As a floating dock, its lifting power will be 10,000 tons, and it will lift ironclads, cruisers or liners of any length, providing their dead weight does

not exceed this figure. When used as a graving dock for short heavy ironclads its lifting power can be increased to 12,000 tons or more, providing the length of the vessel does not exceed 383 feet. That is to say, it could dock vessels such as the Inflexible or Renown of our own navy, or the Brennus and Jauréguiberry of the French navy. It is to be capable of lifting a vessel of 10,000 tons clear of the water in 150 minutes. It is to be built of mild steel throughout, and is so designed as to be self-docking in all its parts. It will be built in England and towed out to its destination. The dock is to be delivered in complete working order at Havannah 11 months after the signature of the contract, and the contract price is £119,000.

[HOLLAND.]

DUTCH NAVAL PROGRAM.

[ENGINEERING.]

The Dutch Government has published a program of reorganization of the Navy. According to this program 12 protected cruisers will be built of the same type as the three cruisers now building, except that the armor shields for the guns of 15 and 12 centimetres will be made 150 millimetres (6 in.) thick and those of the 7.5 centimetre guns will be made 75 millimetres (3 in.) thick. The speed of these cruisers is to be 23 knots, the same as the speed of the Holland, Friesland, and Zeeland now building. Six armored vessels are also proposed of the same type as the Kortenaer, the Evertsen, and the Piet Hein, which went into commission at the end of last year and in the beginning of this year. Some modifications will be made, however, in the armament, viz., instead of three guns of 21 centimetres, 32 calibres, there will be two guns of 24 centimetres and 40 calibres, each of them in a barbette tower; two quick-firing guns of 15 centimetres will be replaced by four quick-firing guns of 12 centimetres, protected by closed shields of 5-centimetre steel. Their displacement will be 3936 tons with 17 feet 6 inches draft. The engines, of 5300 indicated horse-power, are to give a speed of at least 16 knots. The 12 cruisers are destined for the colonies, together with the three cruisers building. The six armored steamers and the three that lately went into commission are intended for the defense of the country. For coast defense, three monitors, type A (larger type, about the same type as the Reinier Claessen), and three monitors, type B (smaller type) are proposed, together with 15 gunboats, 15 torpedo boats, type A (30 knots), six torpedo boats, type B (23 knots), and 10 torpedo boats, type C (18 to 20 knots). For protection of the fishermen three schooners are proposed. The monitors, type A, will have a displacement of 1500 tons, a protective deck of 50 millimetres (2 in.) thick, 200 millimetres (8-in.) armor, two guns of 21 centimetres, 40 calibres long, in two barbette towers, four quick-firing guns of 7.5 centimetres, protected by 25-centimetre (10-in.) shields, four quick-firing guns of 3.7 centimetres. The engines are to develop 700 indicated horse-power. Speed to be at least 9½ knots. Bunker capacity 60 tons. Draft 10 feet 4 inches. The monitors, type B, to have a displacement of 1406 tons, a protective deck of 50 millimetres (2-in.) thick, armed with one gun of 21 centimetres (40 calibres long), in a barbette forward, 200 millimetres (8-in.) armor, 150-millimetre (6-in.) shields, one quick-firing gun 12 centimetres (40 calibres long) aft, with a closed shield of 50 millimetres (2-in.) thick-

ness; four quick-firing guns of 7.5 centimetres, with shields of 25 millimetres (1-in.); four quick-firing guns of 3.7 centimetres; 680 indicated horse-power, 9½ knots speed, 60 tons bunker capacity, draft 9 feet 8 inches. The gunboats to have a displacement of 475 tons, with a protective deck of 25 millimetres thickness, four quick-firing guns of 7.5 millimetres, protected by shields of 25 centimetres, four quick-firing guns of 3.7 centimetres, 550 indicated horse-power, 11¾ knots speed, 23 tons bunker capacity, draft not to exceed 8 feet 4 inches. Torpedo boats, type A, displacement 130 tons, two quick-firing guns of 3.7 centimetres, two torpedo tubes, 15 tons bunker capacity, and 30 knots speed. Torpedo boats type B to be the same as the Dutch torpedo boats named with the letters from A to N. Torpedo boats type C to be of the type as the Dutch torpedo boats designated by figures from III to XXII. The naval estimate for the building of these cruisers is 80,535,000 guilders, or say £6,750,000. The Dutch fleet is manned by 715 officers and about 10,000 non-commissioned officers and men, in addition to the Government navy in India.

		Guilders.
Estimated cost of each	cruiser	2,925,000
" " "	armored vessel	3,640,000
" " "	monitor, type A	1,520,000
" " "	monitor, type B	1,280,000
" " "	gunboat	350,000
" " "	torpedo boat, type A	460,000
" " "	" type B	170,000
" " "	" type C	60,000
" " "	schooner	475,000

[BRAZIL.]

AMAZONAS.

The Amazonas, cruiser, built to the order of the Brazilian Government, was launched by Sir W. G. Armstrong and Co., Elswick, Newcastle-on-Tyne, on December 4. She is a sister ship of the Barrozo, launched in August. The Amazonas is built entirely of steel and is sheathed with wood and copper. She is protected by a steel armor deck. The vessel will be fitted with machinery of 7500 indicated horse-power, and is expected to attain a speed of 20¼ knots with natural draught. The bunkers when full will carry 700 tons of coal, enabling the ship to traverse about 8000 knots when cruising at a moderate speed. Her dimensions are:—Length, 330 feet; breadth, 43 feet 9 inches; mean draft, 16 feet 10 inches; displacement, about 3450 tons. The armament will comprise six 6-inch quick-firing guns, four 4.7-inch quick-firing guns, ten 6-pounder quick-firing guns, four 1-pounder quick-firing guns, four Maxim guns, and three torpedo tubes.

[CHILI.]

CAPITAN ORELLA.

Messrs. Laird Brothers, of Birkenhead, on the 30th of September took out the Capitan Orella, the first of the 30-knot destroyers they are building for the Government of Chili, and made her full power official trial on the Clyde. The mean speed obtained on six runs was 30.17 knots,

with 361 revolutions, and the average revoluti
were 362.5, giving a somewhat higher average
the continuous running. There was a fresh bre
a lumpy sea, but the vessel proved a very ste
satisfaction with her performance was express
Medina, who represented the Chilian Naval Co
Chilian officers who were on board.

Munos Gamero.

On October 15 was held the trial trip of the
the second of the four torpedo boat destroyers
Laird Brothers for the Chilian Government. O
speed averaged 30.42 knots with 369 revolution
run the speed averaged above 30 knots with 364

There was launched from the yard of Messrs.
on December 3, the first of six first class torped
constructed by this firm for the Chilian Gove
boats are of the Viper type.

[Argentine.]

Torpedo Boat Destroy

The Entre-Rios.

The results of the three hours' trial with the
mean speed of 26.75 knots with 365 revolutions,
table:

Hour.	Steam.	1st Receiver.	2nd Receiver.	Vac.	Air forward.	Air aft.
h. m.	lb.	lb.	lb.	in.	in.	in.
11 34	148	67.5	10.5	25	1.5	1.75
11 44	150	65.5	10.0	25	1.5	1.75
11 52	150	67.0	10.0	25	1.5	1.75
12 2	146	62.5	9.5	25	1.5	1.75
12 11	145	61.0	9.25	25	1.5	1.75
12 20	145	60.0	8.5	25	1.5	1.75

The Misiones.

The Misiones, another of the Argentine arm
stroyers built by Messrs. Yarrow and Co., was
trial at the mouth of the Thames, October 9. A
run was made, loaded with 35 tons, when a me
was realized, being 1.1 knots in excess of the con
The Argentine Government was represented by
the Commission: Mr. Hughes, Engineer to the
enant Barbara. Steam was supplied by six of
tube boilers. The consumption of coal on the thr
tried up to this date compares most favorably w
in similar vessels in the British Navy. In the ca

consumption on the three hours' full speed run was 9¾ tons, on the Entre Rios it was 10½ tons, and on the Misiones it was 11¼ tons.

The Corrientes.

The fourth of the torpedo boat destroyers constructed within 12 months from the date of laying the keel was launched with engines and boilers on board, October 10, and the official trials took place on November 18, with following results:—draft, aft, 4 feet 11 inches; forward, 3 feet 11 inches; mean, 4 feet 5 inches. The load was 35 tons, and there were 56 persons on board. The boat left Gravesend at 10.7 and returned at 3.35. At starting the coal on board was 22 tons, and the total burnt in 3 hours was 10 tons 13 cwt. The automatic feed worked perfectly. The following table gives the results:

Time of Day.	Steam.	Pressure in First Receiver.	Pressure in Second Receiv'r.	Vacuum.	Air.	Mean Revolutions.	Time on Knot.	Speed.	Mean of Means.
h. m.	lb.	lb.	lb.	in.	in.		h. m.		
11 4	157½	67	11	25	1½	379	2 12	27.272	27.359
11 14	150	67	10½	24½	½	375	2 9	27.906	
11 26	152½	69	10½	25	1	376	2 10	27.692	
11 37	148	64	9½	25	1¼	364	2 15	26.666	
11 48	150	63½	10	24	1¼	367	2 10	27.692	
11 56	150	67	10½	24½	1½	372	2 15	26.666	

The mean revolutions on the miles were 372, and the mean speed on miles was 27,359. The three hours' trial commenced at 10 hours 33 minutes, and on arrival at the Maplins, 6 miles were run as above. During the three hours the average steam pressure was 151 lbs., and the engines made 67,090 revolutions, equal to 372.7 per minute; average speed, 27.410 knots. The boilers and engines worked perfectly.

[China.]

A number of torpedo boats, built at the Schichau Works, were delivered to China in the past year, reaching their destination in about 30 days. In consequence of the satisfactory trial trips which followed their arrival, new orders were placed by the Chinese Government.

Four new torpedo cruisers are ordered in Elbing, to make 32 knots, with 6500 H. P. The hulls to be of nickel steel, boilers and engines to be of the Schichau type. They are to be completed in 13 months and to proceed to China under their own steam.

BOOK NOTICES.

THE PROGRESS OF ARTILLERY. NAVAL GUNS. By James Atkinson Longridge. E. F. Spon, London. Spon & Chamberlain, 12 Cortlandt Street, New York.

The substance of Mr. Longridge's "Progress of Artillery" may be summed up in the following propositions:

1. A very great increase of ballistic power has resulted from the use of so-called smokeless powders, due to the fact that these powders are entirely converted into gas, whereas of the old charcoal powders only 43 per cent. is so converted.
2. A still further increase of ballistic power can only be obtained by the discovery of a more powerful powder; by a modification of the gun; or by allowing higher pressures in our present guns.
3. The discovery of a more powerful powder is unlikely, as it would have to be an explosive of a nature as yet unknown to our chemistry. Modifications of the gun, such as lengthening bore and increasing chamber capacity, are at the expense of lightness and mobility, already too much sacrificed.
4. Consequently the only practicable way of obtaining a further great increase of ballistic power is by increasing our working pressures.
5. This can be done safely now that we are using wire wound guns.

Probably most persons who have studied ordnance questions will agree in the main with all the foregoing propositions, but it by no means follows that the results which Mr. Longridge thinks should ensue are, as he believes, postponed only by conservatism. In the first place, it is not lack of strength which prevents the adoption of higher pressures with our present guns, but the fact that the erosion of the bore increases rapidly as the pressure increases. We use moderate working pressures so as to prevent our guns from being worn out by the number of shots that would perhaps be fired in a single action.

In the second place, it is very doubtful if the wire gun is any stronger than the built-up one. The elastic strength of the wire is, to be sure, greater than that of the steel rings it replaces, but it must be remembered that the wire can only be made in comparatively short lengths, and consequently must be frequently spliced, and it is the strength of the joint, always much less than that of the wire itself, which determines the strength of the wire layer as a whole. Again, it is really the elastic strength of the tube itself which limits the safe pressure in the bore, and the hoop forgings which are now used, in the United States at least, are amply strong to allow the tube metal to pass from the limit of elastic compression to that of elastic extension, without being themselves unduly strained.

Mr. Longridge's views in regard to rifling of increasing twist are not in accord with those usually held, and appear to have no good founda-

tion. Neither does Mr. Longridge's easy acceptance of the statements of the makers of ammonium nitrate powders afford a sufficiently good reason for the reader to consider that they have completely solved the problem of making a cheap, reliable, low temperature, high power, smokeless powder, better than anything any one else has yet made. Generally speaking, Mr. Longridge appears to take too narrow a view of things and to be too much of the opinion that people who do not agree with him are behind the times. A great deal can be said in opposition to his various propositions, such as the reduction of calibre of naval guns, and the reader should not accept them as authoritative without studying the opinions of those who have had the practical experience in ordnance matters which the author evidently lacks.

P. R. A.

The Hotchkiss Automatic Machine Gun (Rifle Calibre). Harrison and Sons, St. Martin's Lane, London.

This pamphlet gives full description with copious plates and illustrations of the Hotchkiss Automatic Machine Gun, rifle calibre. This new gun, in general design and in detail, is a radical departure from all former types. The first round is fired by hand, after which the operations of loading, firing and extracting are carried on automatically, but under complete control of the gunner. Slow fire may be delivered at any rate up to about 100 rounds per minute, and rapid fire from 500 to 600 rounds per minute. It may be arranged to fire any of the forms of small arm ammunition in service. The weight of the gun is 33 lbs.

The general description of the gun is as follows:

The gun consists of a single barrel, screwed into the front of the receiver which contains the operating mechanism; below and parallel to it is secured a hollow cylinder, which is in communication with the bore through a port drilled through the barrel, a few calibres from the muzzle. Contained in this cylinder is a piston on which are formed suitable cams for operating the breech block, the firing and the feed mechanism. On discharge, as soon as the bullet has passed the port connecting bore and cylinder, the powder gas enters a chamber in the front end of the cylinder and throws the piston to the rear, where it is held by an ordinary sear. On releasing the sear, by pressing the trigger, the piston is thrown forward to its initial position by the main spring. It is obvious that if the sear is held out of engagement by pressing the trigger, and the supply of cartridges be kept up, the piston will have a constant reciprocating motion.

The piston engages with the breech block, and by its motion opens the breech, pushes the cartridge into the chamber, closes the breech and fires. On opening the breech it extracts the fired cartridge case, and brings a fresh cartridge to the loading position, performing, in other words, the functions of a soldier's hand when operating a straight pull rifle.

The cartridges are carried in flat brass feed-strips, having a length of about 38 centimetres and each containing thirty rounds. Each feed-strip is packed in an ordinary pasteboard box, from which it is fed directly through the gun.

The feed mechanism consists of a feed-wheel which engages in cams cut in the piston, and register with openings formed in the feed-strip; each backward and forward motion of the piston brings a fresh cart-

ridge in line with the chamber ready to be pushed home by the breech block and fired.

The gun is fitted with a shoulder-piece or stock, which the gunner brings to his shoulder, and with a pistol-grip and trigger for controlling the fire. Aiming and firing are therefore carried out, as in all Hotchkiss guns, with the same facility as when firing a rifle from a rest.

Two men are required to work the gun, one to load and the other to fire, but a single man can work it in case of necessity.

H. G. D.

Der Krieg Oesterreichs in der Adria im Jahre 1866 (Austria's war in the Adriatic in 1866). Seekriegsgeschichtliche Studie verfasst von Ferdinand Ritter von Attlmayr, gewesener K. K. Corvetten Capitan im Flaggen Stabe des Vice Admirals W. von Tegetthoff. Published by the editors of Mittheilungen aus dem Gebiete des Seewesens, Pola.

The above interesting historical study of the conflict between the Austrian and Italian navies in 1866 is a very valuable contribution to naval history. The work of some 200 pages is illustrated with 4 heliotypes from portraits, 14 photo-engravings, 5 charts and 11 diagrams. Particular attention is called to the two-page engraving that represents the sinking of the Re' d'Italia, at the battle of Lissa, by the Austrian flagship Erzherzog Ferdinand Max; it is a copy of the painting by the famous marine painter Bolamachi.

The author, from having been a commander in the Austrian Navy at the time, having been personally identified with the preparations for the war and actively taking part in it as a member of the personal staff of Admiral Tegetthoff, is especially competent to give a true account of the events of those stirring few months. In the preface he states that the work is a study as well as history, his aim having been to render an impartial account of the occurrences, from which follow natural deductions and conclusions relative to naval strategy and policy. In preparing the work resort was had to official reports and documents at Vienna, the accounts of participants and personal recollections. For Italian sources of information were used Randaccio's Storia della Marina militare Italiana dal 1860 al 1870, and other reliable Italian works notable for their impartiality.

The first chapter is devoted to the condition of the Austrian Navy in the spring of 1866. It considers the military problem confronting the fleet, and the nature of its defensive operations in prospect of the approaching war.

The second and third chapters deal with the equipment and preparations of the Austrian fleet for the war, with events up to the battle of Lissa.

The fourth chapter is devoted to the preparations and operations of the Italian fleet up to date of the battle of Lissa. The last chapter is a detailed description of the battle of Lissa.

The whole work breathes the admiration of the author for Vice-Admiral Wilhelm von Tegetthoff, to whom the book is dedicated. It shows how the unceasing efforts of Tegetthoff, in face of apathy and reluctance of the authorities at Vienna, finally succeeded in having the fleet mobilized. The state of the Austrian Navy as late as the middle of April, 1866, was appalling. But by constant urging and ceaseless work the armored ships were completed in the course of a few weeks, wooden

vessels strengthened by outside extemporized armor of cable or rails, and a squadron collected with Fasano channel as a base of operations. Unceasing drills and exercises, especially at concentrated fire, were held, and as soon as a nucleus of a fleet was obtained, drills underway, tactical and divisional evolutions were pushed. The ceaseless activity of the leader inspired emulation in all his juniors, and even with the few weeks of preparation the Austrian fleet was ready to meet its superior opponent.

The author's account of the battle of Lissa will become the standard one to be referred to by students of naval engagements. The careful attention to details, the impartial relating of the stirring events of that July morning will recommend itself to every reader, impressing him with its authenticity.

H. G. D.

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OCTOBER 16. Harbors and Waterways. Railway Ferry Steamer. Nine Months Clyde Shipbuilding. H. M. S. Powerful.

OCTOBER 23. Grant's Automatic Sights for Coast Guns. Trials of Powerful.

OCTOBER 30. Calculating Riveted Joints. The Harman Feed-water Heater.

NOVEMBER 6. Accident to a Canet Quick-fire Gun. Experiments with Explosives in France. The Dudley Power Pneumatic Gun.

NOVEMBER 13. Navies of the World. Pumping Engines and Plant for Yokohama Dock.

NOVEMBER 20. The Stability of Ships. The Navies of the World.

NOVEMBER 27. Modern Japan—Industrial and Scientific. Feed-pumps, H. M. S. Minerva. Armored Torpedo-boat Destroyers. Canet's Concentric Ring Breech Apparatus. The Herstal Small-arms Factory. New Armor-piercing Projectiles.

DECEMBER 4. The Trials of the Powerful. Corrugated Metallic Life-buoys. Internal Corrosion in Steam Boilers. The Present Status of the U. S. Navy.

DECEMBER 11. Modern Japan. Launch of H. M. S. Proserpine. Additions to the United States Navy.

DECEMBER 18. Her Majesty's Battle-ship Prince George [gives full description of the vessel]. Ships and Guns. Abbott's Boat-raising and Lowering Davit.

THE STEAMSHIP.

OCTOBER, 1896. Marine Boiler Explosions. The Largest Sailing Vessel Afloat. Expanding Boiler Tubes by Power. The Atlantic Greyhound of the Future. The Mercantile Navies of the World. A New Battle-ship for Japan. The New Battle-ship Caesar. The New Japanese War-ship Fuji. Launch of Battle-ship Illustrious. The Trials of the Battle-ship Victorious.

NOVEMBER. Marine Boiler Explosions. The Austrian Torpedo-cruiser Magnet. Ship and Stokehold Ventilation. Remarks on Sail and Steam Power Combined. The New American War-ships. Launch of H. M. S. Diadem at Fairfield.

DECEMBER. Marine Boiler Explosions. Wotherspoon & Davies Patent Machine Feed-water Filter. Casey's Patent Bulkhead Door. Baxter's Steering Gear.

TRANSACTIONS OF THE NORTH-EAST COAST INSTITUTION OF ENGINEERS AND SHIPBUILDERS.

VOL. XII., 1895-96. The Application of the Law of Similarity to Marine Propellers.

An Investigation into the Forces Tending to Produce Vibration in High-speed Engines.

Some Structural Details of Modern Ships.

The Determination of the Forces which Produce Vibrations with Three-crank Engines at High Speeds.

Notes on the Maintenance and Repairs of Marine Boilers.

MINUTES OF PROCEEDINGS OF THE INSTITUTION OF CIVIL ENGINEERS.

VOL. CXXV., 1895-1896, Part III. The Thermal Efficiency of Steam Engines.

VOL. CXXVI. American and English Methods of Manufacturing Steel Plates. Magnetic Data of Iron and Steel.

UNITED SERVICE GAZETTE.

SEPTEMBER 25, 1896. The French Naval Manœuvres—I. Military Training of Dogs. The Future of the Naval Cadet.

OCTOBER 3. The French Naval Manœuvres—II. Remarkable Battle Casualties.

OCTOBER 10. What War Means—I. Effect of the Small-bore Rifle and Surgery. A Volunteer Reserve for the Navy.

OCTOBER 17. Armor and Heavy Ordnance. What War Means—II. War-ship-building in the United States. New First-class Cruisers.

OCTOBER 24. What the Country Owes to Nelson. The Penetration of the Lee-Enfield Bullet.

OCTOBER 31. The French Naval Manœuvres—III. Ranging by Clinometer. The Position of the Marines.

NOVEMBER 7. The Forces Made Use of in War. The Church in the Navy and Army. The Navies of Great Britain and Foreign Countries.

NOVEMBER 14. Trafalgar and To-day—II. Australian Defense.

NOVEMBER 21. Trafalgar and To-day—III. Austrian Artillery. The Development of the Japanese Army and Navy.

NOVEMBER 28. Supply of Ammunition to the Firing Line. Comparative Sea Power.

DECEMBER 5. The Speed Power of the Torpedo-boat Destroyer. Supply of Ammunition to the Firing Line—II.

DECEMBER 12. The Medical Officer in Action. Civilization and War.

DECEMBER 19. The Dutch Navy. Automatic Fire-arms. The Command of the Sea. A New Lee-Medford Bullet.

PROCEEDINGS OF THE ROYAL ARTILLERY INSTITUTION.

OCTOBER, 1896. Shrapnel Fire of Field Artillery. Ranging by Clinometer. Flight and Flying-machines.

NOVEMBER. Astronomical Problems. The Kashmir Imperial Service Artillery. Notes on Austrian Artillery. The Coast Defenses of Northern Tunis. Range Officer.

DECEMBER. Competitive Practice in the Garrison Artillery and its Effect on the Training of Officers and Men. The Dutch Expedition to the Island of Lombok, 1894. Statistics of the Siege of Sebastopol.

MORSKOI SBORNIK.

SEPTEMBER, 1896. War Games in the U. S. Navy. The Italian Expedition to Abyssinia. Experiments with Models of Ships' Screws. The Signification of Side Keels in Battle-ships

of To-day. Notes on Metallurgy. Carrier-pigeon Service in Time of War. Notes from the War Journal of A. Rimski-Korsokoff.

OCTOBER. The Cradle of the Russian Fleet. Naval War of the Future. The Italian Expedition to Abyssinia. The Function of the Engineer. Mechanism Afloat in Time of War. Recent Advances in Matters Pertaining to Armor. The Question of Ships' Speed. Trials of the Turning Power of Torpedo-boats.

NOVEMBER. Commerce Destroyers in War. The Function of the Engineer. Mechanism Afloat in Time of War. Recent Improvements in Marine Engines. Notes on Metallurgy. Russian Explorations in the Sea of Marmora in 1894. The Gyroscope-collimeter (instrument for determining horizon for nautical observations at sea).

In this last number appears the following in relation to liquid fuel:

Experiments with naphtha fuel are in general progress in the navies of all nations, and the great value of the system is becoming generally appreciated. At the present time, in Germany, very large reservoirs are being built at Wilhelmshaven for the storage of naphtha residue, and it is proposed to construct similar reservoirs at Kiel and Dantzic.

In Italy liquid fuel is already in use for torpedo-boats, and is being introduced on large vessels as an auxiliary to the usual coal firing, for obtaining full speed without resorting to forced draught, etc.

J. B. B.

ANNALEN DER HYDROGRAPHIE UND MARITIMEN METEOROLOGIE.

VOL. IX., 1896. Photographs of Lights and Landmarks in Singapore and Malacca Straits. Sailing Directions for Wauchaufoo. Typhoon Highways in the Far East.

VOL. X. Hydrography of Samoan Islands. Some Notes on Trinidad, West Indies. Graphic Representation of the Errors in Observations for Latitude and Longitude. The Bore of the Tsien-tang-Kiang.

DEUTSCHE HEERESZEITUNG.

NO. 77, SEPTEMBER 23, 1896. Controlling the Movements of Several Armies. New Russian War-ships.

NO. 78. The French Autumn Manœuvres. Studies in Past Tactics. Russia's Volunteer Fleet.

The volunteer fleet of Russia in the Black Sea, destined for communication with Vladivostock, is subsidized under the Navy Department, with a naval officer at its head, and the vessels carry the man-of-war flag. In case of war they will be armed quickly; the batteries, ammunition and stores are ready at Odessa, Nikolajew, Sebastopol and Vladivostock.

These vessels, fitted as transports, have received permission from the Porte to pass through the Bosphorus and Dardanelles. New vessels are being built in England and France. They are of the "Pamjaty Mercuria" type, of 10,000 tons displacement, 20 knots speed, with destined armament of six 6-inch and eight 4.8-inch R. F. guns, besides a number of smaller guns. Four new vessels are to be added this year. The fleet at present contains 9 vessels.

Nos. 79-80. German Siege and Fortification Guns. Studies in Past Tactics (conclusion). Report on the Foundering of the Iltis.

Nos. 82-83. Fighting Tactics of Cavalry. Cavalry Weapons.

No. 86. Mounted Artillery with Cavalry Divisions.

No. 89. The First English Campaign in Matabele Land.

No. 90. The First English Campaign in Matabele Land (conclusion). Mounted Infantry in England. Laws relating to Messenger Pigeons in France. The following laws were promulgated:

Art. 1. Every person desiring to erect a pigeon cote must first obtain permission from the prefect of department.

Art. 2. Every person keeping permanently, or receiving temporarily, any pigeons, must notify the mayor within two days, with the place whence received.

Art. 3. There will be an annual census of pigeons, on a day determined by the Minister of the Interior, conducted by the local officials.

Art. 4. Every infraction of Arts. 1 and 2 will be punished by a fine of 100 to 500 francs. In addition, imprisonment for a term of 3 months to 2 years will be inflicted upon any one sending messages which may affect the safety of the state.

Art. 5. The Government may, upon recommendation of the Ministers of the Interior or of War, stop the introduction of pigeons from other countries, and any domestic pigeon service. Infractions of this article are punishable in the manner indicated in second paragraph of Art. 4.

H. G. D.

MILITÄR WOCHENBLATT.

Nos. 84 and 85, September, 1896. Modern Repeating Arms (illustrated).

The article is devoted to a full description of Borchardt's repeating pistol, the construction of which is such that the recoil on firing opens the breech block, ejects the empty shell, cocks the firing pin, inserts a new cartridge into the chamber, and finally closes the breech, so that the pistol is ready to be fired after each discharge.

The magazine is in the pistol grip, holding eight cartridges. The barrel has a longitudinal play, and the recoil drives the barrel and breech mechanism to the rear, and by ingenious devices the above operations are automatically performed. The calibre is 7.65 mm., with a barrel 190 mm. in length. Weight, 1275 grms. Initial velocity 25 m. from muzzle is 400 m. per second. The penetration at 10 m. distance is through 2 men; or through 20 pine planks each 20 mm. thick, placed behind each other at 13 mm. apart. At same distance the bullets have pene-

trated a freely suspended steel plate of 3 mm. thickness. The rapidity of fire is surprising, 24 shots have been fired in 10 seconds, including the time for inserting 2 filled magazines. Tests have resulted in showing that shots are delivered at the rate of 22⅓ per second, or 1340 per minute, with the automatic firing arrangement.

There is practically no recoil upon the hand, as the force of recoil is exhausted in doing work. The pistol is especially adapted to cavalry use.

No. 87. Small-arm Targets.

Nos. 89 to 94. A Review of the Latest Inventions and Discoveries in the Military Field. The English Fleet. Trial Trip of the Victorious. Personnel of the Russian Navy at Sea.

The personnel actually at sea this year numbers 32,477, of which 14 are admirals, 1358 officers of different corps, 476 midshipmen, 336 engineers, 135 doctors, 37 chaplains, etc., 29,850 bluejackets and men. Five naval constructors are at sea.

No. 95. Armies and Fleets of the Present Day.

Nos. 98 and 99. Germany's Naval Policy and Naval Strategy.

The author, drawing lessons from the writings of Captain Mahan, points out strongly the need of a powerful German fleet of battle-ships for defensive and offensive operations in the future against England, Germany's probable future antagonist. He points out the growing commerce of Germany, making her England's most formidable rival, and, judging by past history, predicts England's resentment. He urges preparedness for this future struggle. An invasion of England made possible, the articles of peace may be dictated in London.

No. 100. Cavalry Attack in Extended Order. First Aids on the Fighting Line. H. G. D.

MITTHEILUNGEN AUS DEM GEBIETE DES SEEWESENS.

Vol. XXIV., No. 10. Events at Sea during the Franco-Prussian War. Electric Motor for a Submarine Torpedo-boat. The Imperial Torpedo-boat Viper. Water-tubular Boilers on Holland's Cruisers. Foreign Navies.

No. 11. Engines of English War-ships. Progress in Armor and Ordnance during 1895. Yarrow's Automatic Feed. Reed's Water-tube Boilers for the English Destroyers. Foreign Navies.

No. 12. Ventilation on Board Ship. Tactical Problems in Naval Warfare. Defenses of the Coast and Approaches to Spezzia.

Gives full description, with chart, of the forts and batteries about Spezzia harbor.

Foreign Navies.

MARINE RUNDSCHAU.

October, 1896. Marine International Law in Time of War. Notes on Graphic Solutions of Problems in Spherical Trigonom-

etry. Detonating Explosives and Smokeless Powders. Tests of a Dürr Water-tube Boiler. The Arcona Class. Foreign Naval Notes.

NOVEMBER. The History of the Fleet. Does our Navy need a War College? The Imperial Gun-boat Iltis. Peculiarities of Vessels of the Brandenburg Class. Organization and Development of the French Lighthouse System. The Navy of the United States. Endeavors towards the Mental, Moral and Social Elevation of English Sailors. Foreign Naval Notes.

DECEMBER. The History of the Fleet (continued). Germany's Sea Power. Burial of the Crew of the Iltis. Data on Steam Launches for Imperial Ships. Trial Trips of the Hecla. The Burning Coal Cargo of Sailing Ship Emilie, and how it was Saved. Organization and Development of the French Lighthouse System (concluded). The Navy of the United States (contiued). Foreign Naval Notes. H. G. D.

LE MONITEUR DE LA FLOTTE.

NO. 36, SEPTEMBER 5, 1896. Petroleum as a Fuel.

The use of petroleum for steaming purposes has been adopted on board all torpedo-boats in the Italian Navy. In Germany and Russia this fuel is daily growing in favor in the form of a residuum called astatki or mazout, resembling ordinary molasses. Its low price and high degree of combustibleness make it preferable to refined petroleum. In petroleum-producing countries like the United States, the cost of the article would be relatively insignificant.

NO. 37, SEPTEMBER 12. The Eckmuhl Lighthouse and the Men-Hir Beacon.

The Eckmuhl Light, at Point Penmarch, Brittany, begun in 1894, is rapidly approaching completion, and will be placed in operation in September, 1897. The average range of its electric rays will measure 100 kilometres. It will possess all the most recent improvements in machinery, etc.

NO. 43, OCTOBER 24. Questions of the Navy Personnel in regard to "L'Ecole des Hautes Etudes Navales."

NO. 44, OCTOBER 31. Speed an Illusion.

NO. 46, NOVEMBER 14. The Navy Bill: Report of M. de Kerjégu, Chairman of the Naval Committee.

NO. 50, DECEMBER 12. The Naval Program. J. L.

REVISTA TECNOLÓGICO INDUSTRIAL.

SEPTEMBER, 1896. Altimetry. Dampness in Cotton Spinning.

BOLETIN DO CLUB NAVAL.

AUGUST, 1896. Fuses in the Navy. Odontalgy in the Navy. Tables of Firing. The Climate of Rio de Janeiro.

SEPTEMBER. The Argentine Fleet. A Short Study of the Fuses in Use in the Navy (continued). Movements of Foreign Navies in the Port of Rio. Odontalgy in the Navy (continued). Tables of Firing.

REVISTA MARITIMA BRAZILEIRA.

AUGUST, 1896. The Late Improvements in Naval Ordnance and Armor. The Speed Problem. Petroleum as a Means of Raising Steam.

OCTOBER. Submarine Navigation. Spherical Trigonometry. The Cruiser Barros. J. L.

REVUE DU CERCLE MILITAIRE.

NO. 36, SEPTEMBER 5, 1896. The War Department, Military Cabinet and General Staff in Germany. The Field Sanitary Service.

NO. 37, SEPTEMBER 12. The Service in the Field: Remarks on the Regulations of May 28, 1895.

NO. 38, SEPTEMBER 19. The Service in the Field, etc.

NO. 39, SEPTEMBER 26 and OCTOBER 3. Letters from Madagascar.

These letters, written by a captain of artillery journeying from Tamatave to Antananarivo, give a graphic description of the nature of the country traversed and its inhabitants. Incidentally the correspondent refers to the discontented Tahavalos, who are active, through their brigandage, in retarding reorganization and return to prosperity in the island, but does not otherwise attach great importance to the so-called insurrection mentioned in the papers.

NO. 41, OCTOBER 10. The Transsiberian Railway. The Oviedo Factory and the First Spanish Mausers.

NO. 42, OCTOBER 17. The Emperor of Russia and the French Army at the "Camp de Châlons." The French Army Rifle.

NO. 43, OCTOBER 24. Artillery Disposition for an Attack against a Defensive Position. The Service Rifle (continued). The School of Naval Higher Studies.

NO. 44, OCTOBER 31. Army Medical Statistics for the Year 1894.

NO. 45, NOVEMBER 7. The Army and Navy of the Future in Japan.

NO. 46, NOVEMBER 14. Military "Cyclism" and the 2d Army Corps Manœuvres.

NO. 47, NOVEMBER 21. Military "Cyclism," etc.

NO. 48, NOVEMBER 28. The Transsiberian Railway and its Influence in Case of a War in Eastern Asia.

NOS. 49 and 50, DECEMBER 5 and 12. Young Recruits and their Débuts in the Regiment. The Alpine Military Shelters in Italy. J. L.

REVUE MARITIME.

SEPTEMBER, 1896. A Triangle of Lights to Indicate at Great Distances the Course of a Vessel. Installation on board the Brennus of an Apparatus indicating the Direction in which the Engines are working.

"The importance of such a contrivance may be conceived from the fact that recently, owing to the ignorance of the captain of the direction in which the engines were working, the safety of a U. S. man-of-war was imperiled while entering Newport's harbor."

An Attempt at a Classification of the Water-tube Marine Boilers. A Practical Guide to the Conduct of Court-martials on board Men-of-war.

OCTOBER. Determination of the Meridian by Means of the Hour of an Ordinary Watch. Aid to the Wounded in Naval Actions. A Practical Guide to the Conduct of Court-martials, etc. (continued). An Attempt at a Classification of the Water-tube Boilers (continued).

NOVEMBER. Questions of Naval Strategy. Electric Installation on board the Cruiser Bugeaud. A Practical Guide to the Conduct of Court-martials (continued). Aid to the Wounded in Naval Action. Naval Stores and Material in Navy Yards.

J. L.

BOLETÍN DEL CENTRO NAVAL.

JUNE-JULY, 1896. Electricity in the Navy.

AUGUST. Our Future Military Port (Navy Yard). A Report on the Manœuvres and Drills with the Torpedo-boat Flotilla. The Status of Naval Engineers. Steel for Ordnance.

OCTOBER. The Future Military Port.

The establishment of a military port, or navy yard, has been for some time contemplated by the Argentine Republic. The necessity of such a port is admitted by all interested, but the question of site has given rise to lively discussions among experts; Luiggi, the government engineer, being in favor of building the port at Puerto Belgrano, in Bahia Blanca, some 18 hours from Buenos Aires, and Señor Diego Brown, the author of the pamphlet on the subject, at some convenient point in the estuary of la Plata, as being far more advantageous from a strategical point of view. J. L.

LE YACHT.

NO. 968, SEPTEMBER 26, 1896. The U. S. Naval Establishment: its Bureaus, Navy Yards and Private Shipyards (continued). The English Twin-screw Steam Packet between Dieppe and New Haven.

No. 970, October 10. Letters of Mark and Privateering (by V. G.).

French naval writers are far from being of one mind in regard to the advisableness, or non-advisableness, of delivering letters of mark in the case of war with England.

No. 971, October 24. The French Naval War College.

L'Ecole des Hautes Etudes de la Marine is the new name for the naval war school, which was at first established afloat, and lately transferred to Paris, as presenting greater facilities for the pursuit of the higher maritime studies, in the way of public libraries, records, archives, and above all, on account of lectures by eminent men on all subjects pertaining to the Navy.

No. 973, October 31. England's Naval Reserve.

The periodical cry of alarm is again being sent forth as the meeting of Parliament approaches. Though the motive (the weakness of the Navy) deceives nobody, even in England, the artifice never fails, and the result is a heavier call on the exchequer.

No. 974, November 7. On the Use of Wreckage in the Study of Ocean Currents. The Ernest Bazin.

The launch of the Ernest Bazin has fixed anew the attention of the public and experts upon this most curious invention of the roller-boat, and brought forth the most varied comments, both as to its scientific value and practical application. At any rate, M. Bazin is very sanguine touching the final result, and, for that matter, speed calculations bear out fully the previsions of the inventor.

New Naval Constructions in 1897.

No. 975, November 14. Promotion in the Navy.

For years back the French Ministry of Marine has labored hard to find a remedy to that baneful situation, a stagnancy in the Navy, and in spite of numerous bills introduced in Congress, appears as far from a solution of the difficulty as ever.

No. 976, November 21. The Auxiliary Cruisers again (see Yacht of October 10).

No. 977, November 28. The Navy: Six Months in the Rue Royale, by M. Lockroy.

A remarkable paper from the pen of the ex-Minister of Marine.

No. 978, December 5. The Navy Estimates for 1897.

The Navy Bill just reported by M. de Kerjégu, the Chairman of the Naval Committee, points out, in courteous but forcible language, the necessity of reforms in the administration of the Navy, and adds that a powerful fleet, strongly organized, and always ready for immediate action, was never more necessary to France than at the present time.

J. L.

SOCIÉTÉ DES INGÉNIEURS CIVILS.

August, 1896. Electric Traction in Railways.

September. Mechanical Traction Railways and principally Railways with Gas Motors. Theory of Singeing in Compressed

Elastic Pieces. Transmission of Power by Means of Electricity in Coal Mines.

OCTOBER. Trade Manufacture of Carburet of Calcium and Acetylene. J. L.

TRANSLATORS AND REVIEWERS.

Prof. P. R. ALGER, U. S. Navy. Lieut. J. B. BERNADOU, U. S. Navy. Lieut. H. G. DRESEL, U. S. Navy. Prof. JULES LEROUX.

Vol. XXII., No. 4. 1896. Whole No. 80.

PROCEEDINGS

OF THE

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SPECIAL NOTICE.

NAVAL INSTITUTE PRIZE ESSAY, 1897.

A prize of one hundred dollars, with a gold medal, is offered by the Naval Institute for the best essay presented on any subject pertaining to the naval profession, subject to the following rules:

1. The award for the prize shall be made by the Board of Control, voting by ballot and without knowledge of the names of the competitors.

2. Each competitor to send his essay in a sealed envelope to the Secretary and Treasurer on or before January 1, 1898. The name of the writer shall not be given in this envelope, but instead thereof a motto. Accompanying the essay a separate sealed envelope will be sent to the Secretary and Treasurer, with the motto on the outside and writer's name and motto inside. This envelope is not to be opened until after the decision of the Board.

3. The successful essay to be published in the Proceedings of the Institute; and the essays of other competitors, receiving honorable mention, to be published also, at the discretion of the Board of Control; and no change shall be made in the text of any competitive essay, published in the Proceedings of the Institute, after it leaves the hands of the Board.

4. Any essay not having received honorable mention, may be published also, at the discretion of the Board of Control, but only with the consent of the author.

5. The essay is limited to fifty (50) printed pages of the Proceedings of the Institute.

6. All essays submitted must be either type-written or copied in a clear and legible hand.

7. The successful competitor will be made a Life Member of the Institute.

8. In the event of the Prize being awarded to the winner of a previous year, a gold clasp, suitably engraved, will be given in lieu of a gold medal.

By direction of the Board of Control.

H. G. Dresel,
Lieut., U. S. N., Secretary and Treasurer.

Annapolis, Md., *December 31, 1896.*

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Annapolis, Md., *December 31, 1896.*

Please sign this receipt and hand it to the Corresponding Secretary of your Branch, or mail it direct to the Secretary and Treasurer, Annapolis, Md. The address given below should be the one to which *future publications and communications are to be sent.*

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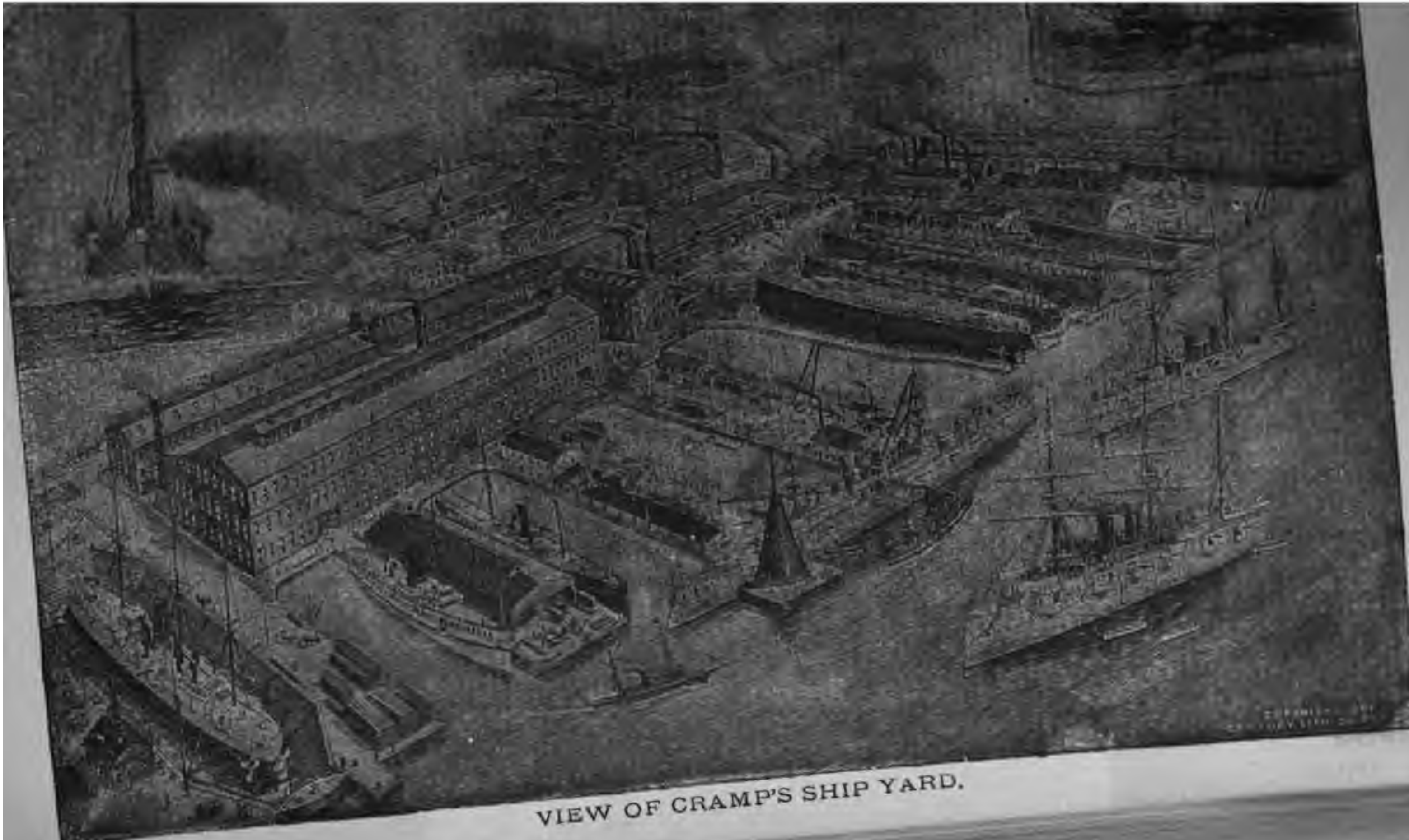

VIEW OF CRAMP'S SHIP YARD.

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NOTICE.

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It now enters upon its twenty-fourth year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

ARTICLE VII.

Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer, or to the Corresponding Secretary of a Branch. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life members, given by proxy or presence, shall be cast, a majority electing.

Sec. 5. Associate members shall be elected from officers of the Army, Revenue Marine, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing.

The Proceedings are published quarterly, and may be obtained by non-members upon application to the Secretary and Treasurer at Annapolis, Md. Inventors of articles connected with the naval profession will be afforded an opportunity of exhibiting and explaining their inventions. A description of such inventions as may be deemed by the Board of Control of use to the service will be published in the Proceedings.

Single copies of the Proceedings, $1.00. Back numbers and complete sets can be obtained by applying to the Secretary and Treasurer, Annapolis, Md.

Annual subscriptions for non-members, $3.50. Annual dues for members and associate members, $3.00. Life membership fee, $30.00.

All letters should be addressed to Secretary and Treasurer, U. S. Naval Institute, Annapolis, Md., and all checks, drafts and money orders should be made payable to his order, without using the name of that officer.

NOTICE.

The U. S. Naval Institute was established in 1873, having for its object the advancement of professional and scientific knowledge in the Navy. It now enters upon its twenty-fourth year of existence, trusting as heretofore for its support to the officers and friends of the Navy. The members of the Board of Control cordially invite the co-operation and aid of their brother officers and others interested in the Navy, in furtherance of the aims of the Institute, by the contribution of papers and communications upon subjects of interest to the naval profession, as well as by personal support and influence.

On the subject of membership the Constitution reads as follows:

ARTICLE VII.

Sec. 1. The Institute shall consist of regular, life, honorary and associate members.

Sec. 2. Officers of the Navy, Marine Corps, and all civil officers attached to the Naval Service, shall be entitled to become regular or life members, without ballot, on payment of dues or fee to the Secretary and Treasurer, or to the Corresponding Secretary of a Branch. Members who resign from the Navy subsequent to joining the Institute will be regarded as belonging to the class described in this Section.

Sec. 3. The Prize Essayist of each year shall be a life member without payment of fee.

Sec. 4. Honorary members shall be selected from distinguished Naval and Military Officers, and from eminent men of learning in civil life. The Secretary of the Navy shall be, *ex officio*, an honorary member. Their number shall not exceed thirty (30). Nominations for honorary members must be favorably reported by the Board of Control, and a vote equal to one-half the number of regular and life members, given by proxy or presence, shall be cast, a majority electing.

Sec. 5. Associate members shall be elected from officers of the Army, Revenue Marine, foreign officers of the Naval and Military professions, and from persons in civil life who may be interested in the purposes of the Institute.

Sec. 6. Those entitled to become associate members may be elected life members, provided that the number not officially connected with the Navy and Marine Corps shall not at any time exceed one hundred (100).

Sec. 7. Associate members and life members, other than those entitled to regular membership, shall be elected as follows: Nominations shall be made in writing to the Secretary and Treasurer, with the name of the member making them, and such nominations shall be submitted to the Board of Control, and, if their report be favorable, the Secretary and Treasurer shall make known the result at the next meeting of the Institute, and a vote shall then be taken, a majority of votes cast by members present electing.

The Proceedings are published quarterly, and may be obtained by non-members upon application to the Secretary and Treasurer at Annapolis, Md. Inventors of articles connected with the naval profession will be afforded an opportunity of exhibiting and explaining their inventions. A description of such inventions as may be deemed by the Board of Control of use to the service will be published in the Proceedings.

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